"A STUDY ON COMPARISON OF NEUROLOGICAL SOFT SIGNS AND MINOR PHYSICAL ANOMALIES BETWEEN SIBLINGS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER CHILDREN AND NORMAL CONTROLS"

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CERTIFICATE

This is to certify that the dissertation entitled **"A STUDY ON COMPARISON OF NEUROLOGICAL SOFT SIGNS AND MINOR PHYSICAL ANOMALIES BETWEEN SIBLINGS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER CHILDREN AND NORMAL CONTROLS."** is a bonafide work done by **DR.JAYENDRA.S** at Madras Medical College, Chennai in partial fulfilment of the university rules and regulations for award of **M.D., Degree in Paediatrics** (BRANCH VII) during the academic year 2012-2015.

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DECLARATION

I, Dr. Jayendra.S, solemnly declare that this dissertation entitled **"A STUDY ON COMPARISON OF NEUROLOGICAL SOFT SIGNS AND MINOR PHYSICAL ANOMALIES BETWEEN SIBLINGS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER CHILDREN AND NORMAL CONTROLS."** was done by me at Madras Medical College and Institute of Child Health and Hospital for Children, during 2012-2015 under the guidance and supervision of **DR.SHANTI NAMBI MD(psy)., DPM.,** This dissertation is submitted to **The Tamilnadu Dr.M.G.R Medical University** towards the partial fulfilment of requirements for the award of **M.D Degree in Paediatrics** (Branch – VII).

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INSTITUTIONAL ETHICS COMMITTEE
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CERTIFICATE OF APPROVAL

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Dear **Dr.Jayendra. S,**

The Institutional Ethics Committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "**A Study on Neurological soft signs and minor physical anomalies in siblings of attention deficit hyperactivity disorder children in comparison with normal controls** " No.15042014.

The following members of Ethics Committee were present in the meeting held on 08.04.2014 conducted at Madras Medical College, Chennai-3.

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We approve the proposal to be conducted in its presented form.

Sd/Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

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INTRODUCTION

INTRODUCTION

Attention Deficit Hyperactivity Disorder is said to be one of the most common neurobehavioural disorder of childhood. It is mostly seen in school going children and it is the most extensively studied mental disorder. It can continue through adolescence and adulthood too.

ADHD is characterized by inattention, distractible at work and problems in maintaining attention, difficult impulse control and reduced inhibition when moving with others. Usually seen symptoms are motor over activity and motor restlessness. The common problems are academic under achievement, problems with family members and siblings, and decreased concentration in studies. The usual co-morbidities of ADHD are emotional problems, language disorders and learning disorders.

ADHD are of 3 subtypes:

CONTENTS

ABSTRACT

INTRODUCTION

Attention deficit hyperactivity disorder is the most common neurobehavioural disorder of the childhood. It is characterised by inattention, hyperactivity and impulsivity. Neurological Soft Signs represent subtle neurological signs that could not be localised to a particular region of brain. Minor Physical Anomalies are subtle phenotypic abnormalities that don't fit into dysmorphic syndromes. Both the NSS and MPA indicate a diffuse brain injury. And both are present in many of psychiatric disorders and behavioural disorders especially ADHD.

AIMS & OBJECTIVES

To study the Neurological Soft Signs and Minor Physical Anomalies in ADHD siblings in comparison with age matched controls. To study the correlations of Neurological Soft Signs and Minor Physical anomalies with respect to gender and socioeconomic class of the children. To study the interrelationship between various domains of soft signs with minor physical Anomalies.

SUBJECTS AND METHODS

Study was conducted in child psychiatry department. Siblings of the children diagnosed of ADHD during the study period, who doesn't have a

feature of neurological or psychiatric abnormality including ADHD, from 8 to 13 years were included in the case group. Normal children were included in the control group. The number of children included in both case and control group were 57. The children included in the study were given revised Physical and Neurological Evaluation of Soft Signs (PANESS) and WALDROP Minor Physical Anomaly Scale and scores were assessed.

STATISTICAL ANALYSIS

The scores of various domains of Neurological Soft Signs and Minor Physical Anomalies were drawn. Independent t test were applied between the two groups. P <0.05 were taken as significant. Similarly correlations were drawn among gender and socioeconomic class with NSS/MPA by Pearson's correlation. Statistical analysis were done by SPSS version 17.0.

RESULTS

Total number of children included in the study was 114. Of that 74 were male and 40 were female. Socio economic class was obtained for each child by modified kuppusamy scale. There is a statistical significance of p< 0.05 in overflow items, gaits and stations, total timed and total PANESS. p> 0.05is noted for minor physical anomalies for both case and control group. There is no statistical difference for males and females for NSS/MPA separately for both the case and control group. There is a positive correlation for overflow items &

timed movements with minor physical anomalies for ADHD siblings in lower middle and upper lower socioeconomic groups.

CONCLUSION

ADHD siblings showed a significant increase in Neurological soft Signs when compared with normal children. While ADHD siblings fail to show a significant increase in Minor Physical Anomalies compared with Normal children. The inter correlation of Minor Physical Anomalies with various domains of soft signs showed positivity for overflow and timed movements, especially for sibling group in lower middle and upper lower group. There is no significant difference between males and females in both sibling group and normal children in Neurological Soft Signs and Minor Physical Anomalies.

KEYWORDS

Attention deficit hyperactivity disorder, neurological soft sign, minor physical anomalies, overflow, timed, PANESS, WALDROP, socioeconomic class, modified kuppusamy scale, DSM-IV criteria.

INTRODUCTION

Attention Deficit Hyperactivity Disorder is said to be one of the most common neurobehavioural disorder of childhood. It is mostly seen in school going children and it is the most extensively studied mental disorder. It can continue through adolescence and adulthood too.

ADHD is characterized by inattention, distractibility at work and problems in maintaining attention, difficult impulse control and reduced inhibition when moving with others. Usually seen symptoms are motor over activity and motor restlessness. The common problems are academic under achievement, problems with family members and siblings and decreased concentration in studies. The usual co-morbidities of ADHD are emotional problems, language disorders and learning disorders.

ADHD are of 3 subtypes:

1. Predominantly hyper activity-impulsivity
    a. Six or more in the impulsivity and hyperactivity categories
    b. Lesser than 6 symptoms of inattention are present, even though some inattention may exist

2. Predominantly inattentive
    a. 6 or more in the inattention component
    b. Lesser than 6 symptoms of impulsivity and hyperactivity are present, though some hyperactivity my exist

3. Combined hyper active, impulsivity and inattention characters
    a. 6 or more than that in the inattention component and 6 or more in the hyper activity and impulsivity component exist
    b. ADHD combined is the most common type.

HISTORY

- ADHD was first described by George Still in 1902.
- It was initially named as Minimal brain damage syndrome.
- In 1937, Bradley reported that d-Amphetamine improved the restlessness and improved concentration in children with behavioural problems.
- In 1960, ICD-9 and DSM-II adopted the term hyperkinetic syndrome of childhood.
- In 1970s, this condition was renamed Attention deficit disorder, as the main disability involved was inattention.

- In 1987, DSM III-R included a single criterion list requiring 8 of the 14 possible symptoms of hyperactivity, impulsivity and inattention for the diagnosis of ADHD. Duration criteria were added such that the behaviours needed to be present at least for 6 months.
- 1n 1994, APA published the 4th edition of DSM, a text revision which is the current version.

ETIOLOGY

There are many factors involved in the cause of ADHD. All these processes lead to a developmental aberration in the brain. Maternal complications for ADHD children are preeclampsia, prolonged labour, and difficult delivery. Maternal smoking, alcohol and drug usage during pregnancy are commonly linked to the hyperactive behaviour of the child.

Genetic cause

The 2 important genes involved in ADHD are the DAT1 which is the dopamine transporter gene and DAT4 which is nothing but a dopamine 4 transporter gene. Other genes that are responsible for ADHD phenotype are DOCK2, Na H exchange gene and DRD5, SLC6A4, SLC6A3, HDR1B etc. Children with features of ADHD, with a specific gene have thinner cortical brain tissue in the attention areas of the brain.

But various studies have shown that the cortical thickness was not permanent and the children with this version of gene develop a normal cortical thickness as they grow up.

Environmental cause

Maternal cigarette smoking and alcohol intake during pregnancy are related to the ADHD as discussed before. Also preschool children living near painting industries are at higher risk developing hyperactive behaviour in future.

Brain injuries

Children who had an insult to developing brain said to develop ADHD in future. But the chances of developing ADHD in children having a severe trauma are rare.

There are various researches suggesting that refined sugar causes ADHD. In one of the study where children are given either refined sugar or a sweetener. The children who had refined sugar for years together had hyperactive behaviour in adolescent age. The result of the study appears controversial.

Food additives

Preservatives and colouring agents are said to be a risk factor for hyperactive behaviour by few recent journals

Neuroanatomical factors

Anterior attention networks said to work for promoting attention, sustaining, executing, focusing and shifting functions. Various studies suggest superior and temporal cortices for attention, external parietal and striatal regions for motor executive functions, hippocampus for memory and brainstem areas for sustaining attention. PET, MRI, SPECT suggests decreased volume in prefrontal areas, anterior cingulate, globus pallidus, caudate thalamus, hippocampus and cerebellum in children with ADHD

Prevalence

The mean worldwide prevalence of ADHD in various studies varies between 5.29 and 7.1% in children and adolescence. The prevalence of ADHD in Europe was estimated fewer than 5%. ADHD can affect children from pre-school age and increasing recognition is given to the fact that ADHD children has persistent symptoms and can extend to adolescence and even adulthood. A higher prevalence is commonly seen in males. ADHD combined type is generally said to be most prevalent among children of all age groups. ADHD is often present along with certain co morbid conditions such as oppositional defiant disorder and anxiety disorder.

In India, there is not much data available for prevalence of ADHD but various studies shows that prevalence of ADHD range from 2 to

16%.The ratio of prevalence of ADHD among males and females were said to be 3:1. Various studies that have been conducted previously showed a male preponderance with male female ratio ranging from 3:1 to about 11:1. 9 and 10 years are said to be the age of highest prevalence of ADHD and studies showed a significant difference between CARS parents and teacher rating score. The teacher rating scale is given higher importance than that of the parents. Behavioural problems were found in 36 percent of the children with ADHD but about 8% of the ADHD children have a family member with similar illness or a psychiatric disorder. About 20 to 25 percent of ADHD children have a co morbid learning disorder but not many learning disorder children have an ADHD incidence in their lives.

Clinical Manifestations

Diagnostic and statistical manual for mental disorders 4th edition in short DSM-IV criteria is essential for diagnosis of ADHD. The importance of ADHD is attained from various field trials. ADHD is a disorder of children usually from 5 to 12 years.

According to DSM IV criteria the behaviour must be inappropriate compared to other children(of the same age group and same developmental level), symptoms should start before 7 years, symptoms should be present at least for 6 months, should be present in 2 settings at

least and should not be secondary to another disorder. The clinical features of ADHD may change with age.

The symptoms may vary from difficulty in performing a motor task and aggression towards a work and hyperactive behaviour which are common in children, whereas inattention and disorganised work predominates in the adolescents and adulthood

Common symptoms of inattention may be easy distractibility, missing details and nuances, forgetting things, difficulty in focussing, becomes bored easily in a task after a few minutes, have trouble in completing home work assignments, loses things at school, not listening when spoken to, day dreaming and struggling to follow instructions.

The hyperactive symptoms consists of constant fidgeting from their seats, excessive talking , playing, touching and dashing around the objects near them, difficulty in eating, constantly in motion especially at school, difficulty in completing home work.

The common symptoms of impulsivity include impatience, blurting out with answers, having difficulty in waiting for their turns, difficulty in following a queue. The DSM-IV criteria for ADHD is given elsewhere

Neurological soft signs

The term neurological soft signs were first noted by Loretta bender in 1940s in reference to non diagnostic abnormalities in the neurological

examination of the children having schizophrenia. Soft signs do not indicate focal neurological deficit but they are associated with wide variety of developmental disabilities and occur more frequently in children with intellectual disability, learning disability and psychiatric disorder.

Soft signs refer to behavioural problems, physical findings and a variety of non focal findings. Soft signs are divided into those that are normal in young children but become abnormal when they persist in adolescents and adults.

Neurological signs are classified into either hard sign or soft sign. Hard signs are nothing but gross motor and sensory deficit as a result of a focal defect. Whereas, soft signs are referred to as nonlocalizing neurological deficits but a specific area of the brain or a specific neurological syndrome could not be ascertained. This distinction is not considered real and there is often a difficulty in establishing a relationship between a brain imaging and the behaviour it is said to be a soft sign.

NSS are commonly belonging to a category where a neuro anatomical localization is impossible. Though these categories vary among authors, the most common region concerned with ADHD is the region of sensory integration, motor capabilities, coordination and

reflexes. The difference in hard and soft signs resulted in classification of neurological signs into two major areas.

Neurological soft signs (NSS) are slightest aberration of a neurological performance on both sensory and motor functioning without a focal lesion. The difficult coordination, reduced speed of work, inaccurate movements like movements involved in balance, rhythm, mirror movements and overflow movements.

NSS is classified as untimed and timed movements. Most important of them are speed of movements followed by rhythm disturbance. Of the individual soft signs involuntary movements and mirror movements have the highest incidence at younger age group. Overflow movements are nothing but the movements that are present in other parts of the body not involved in the voluntary act. NSS are normal in children younger than 6 years as there is reduced development of inhibitory cortical signals targeting other parts not involved in movement. These signs indicate cortical inhibition delay. Dysrhythmia is a difficulty in maintaining normal sequencing of movements. Improper rhythm or timing is involved in the movements to be called as dysrhythmia. They are concerned with regions involved with coordination and motor act like basal ganglia and cerebellum

NSS have various associations especially psychiatric and behavioural disorders, such as schizophrenia, bipolar disorder, obsessive-compulsive disorder, autistic disorder, hyperactive behaviour and learning disorder.

Very few studies have explored the relationship between soft signs and structural brain abnormalities. Most of the studies show a positive relationship. Ventricular space to brain ratio and enlargement of third ventricle is said to be involved in speed of movements and motor coordination. In MRI study, a decrease in gray matter especially in putamen, globus pallidus and thalamus whereas reduction in volume of cerebral cortex is said to be linked to sensory soft signs. Frontal lobe is said to have been involved in Neurological Soft Signs. The sulci , CSF, the fissures, length of the brain, the width of the sylvian fissures, caudate, putamen, sensory association cortex are involved in soft Neurological signs.

However, more the neurological impairment more will be the brain abnormality. But in most of the cases the localisation is impossible and fails to give us many details. Most of the studies show an association between brain structures and neurological signs especially when both occur in patients with poor prognosis or chronic disorder.

Imaging studies are said to more useful in evaluating Neurological Soft Sign. The relationship between soft signs and brain structure is given in various studies especially 3 important studies in the form of nonspecific variables like overall impairment in functioning and structural brain abnormalities

A PET study was conducted however failed to show a relationship between cerebral blood flow and soft signs in both resting and activation states. However, another PET study found a link between neurological impairment, soft signs, and hyperactivity with sensory association cortex. Schroder et al used the MRI to study the sensorimotor areas and association areas during finger thumb tapping. Whereas in children with schizophrenia and their family members have a decreased activity of these regions especially association areas and supplementary motor cortex.

In summary, not much of studies are available that interrelate Neurological soft sign with neuroanatomy and neurophysiology. Many studies have tried to relate to a neurological abnormality and a non specific structural brain damage, there is a need for more studies involving more imaging techniques to find out the relationship between the two in near future.

Minor Physical Anomalies

Minor physical anomalies or dysmorphic features occur with higher than usual frequency in children with developmental disabilities, learning disorders and speech and language disturbance. As with soft signs, the documentation of minor physical anomalies is a part of neuropsychiatric assessment, but it is rarely helpful in the diagnostic process and does not confer good or bad prognosis in most of the situations.

Minor physical anomalies (MPA) include high arched palate, low set ears, hypertelorism, epicanthal folds, transverse palmar creases, multiple whorls of hair and large head. Large and furrowed tongue and partial syndactyly of several toes. Goldfarts (1967) has reported a higher frequency of minor anomalies among people with schizophrenia compared with controls. Papaport et all found out about $1/4^{th}$ of ADHD has a significant minor physical anomalies with score more than 5 Minor anomalies, together with other measures provides some measure of risk which would be of clinical usefulness for screening of ADHD.

MPA are said to be inherited. Various factors responsible for these subtle anomalies are hypoxia, intra uterine infections, antenatal bleeding etc. In fact these act as markers for anomalous babies especially in third trimester. Studies have been conducted to study the developmental

relationship of Minor Physical Anomalies. Most of them suggest a correlation with psychiatric problems, aggressiveness, autism and ADHD.

MPAs were studied in ASD, ADHD and psychiatric disorders. Most of the studies found that autism is interrelated with Minor Physical Anomalies. A study conducted in 1988 showed about 40 percent of the siblings of schizophrenia showed MPA when compared with only 5 percent in the control group. Also similar to soft signs Minor Physical Anomalies children are said to have had a hypoxic intra uterine environment. Hypoxia are said to damage the development of ectoderm as few minor physical anomalies are also a part of ectoderm, hypoxia is said to be the reason for these anomalies. The most common form of minor physical anomaly is high arched palate as it is said to be the precursor of cleft palate. The high arched palate can cause nasal obstruction during night times resulting in the hypoxia of the child. Capillary malformation of the skin and other tissues although occurring sporadically most of the times. Those that cause by RAS mutations are said to be due to hypoxia.

Minor Physical Anomalies (MPAs) are soft morphological abnormalities of the craniofacial region trunk and limbs. They don’t cause a cosmetic significance to the child. They are primarily due to deviation of foetal development especially in first and second trimester due to ectodermal embryonic origins in the developing brain. Genetic

factors and prenatal events, such as maternal bleeding with subsequent foetal hypoxia, gestational diabetes, medication use, or toxaemia, may contribute to MPAs

Minor malformations are qualitative defects of embryogenesis arising during organogenesis deviating from normal. MPA represent minor phenotypic abnormalities. Phenogenetic variants are quantitative defects arising after organogenesis representing equivalents of normal anthropometric variants

Increased percentage of MPAs can be found in patients with schizophrenia, bipolar disorder, ADHD, and Tourette syndrome. Also, MPAs are suggested to be indicators of severity of the illness. MPAs are markers for aberrant development and may be used as markers of risk for certain psychiatric disorders.

Various studies have proved that ADHD have a link with Neurological Soft Signs and Minor Physical Anomalies. Therefore in this study I would like to compare the Neurological Soft Signs (NSS) and Minor Physical Anomalies (MPA) between ADHD siblings and normal controls. If at the end of the study if the difference is statistically significant, ADHD siblings will form a common etiological platform with ADHD children. In future imaging modalities can be developed to find out the aetiology of ADHD.

REVIEW OF LITERATURE

V.C PATANKAR et al from Topiwala medical college in Mumbai studied the Soft Signs and various risk factors like type of delivery, mode of delivery, developmental milestones and correlated the NSS with types and ADHD severity especially the correlation with co-morbid specific learning disorders. The study was conducted in a psychiatry department of a tertiary care hospital. The study design is cross-sectional study.

52 children are included in the study. They are diagnosed of ADHD. These children were given PANESS scale for Neurological Soft Signs. ADHD severity is rated by CARS scale. The data for the test were analysed using chi-square test for qualitative comparison and Pearson's co relational analysis for correlation between two variables

Results showed that NSS are present in 84% of the children with ADHD. They are equally present in both the inattentive and impulsivity types of ADHD. Specific learning disorder associated with ADHD in not dependent on NSS. Impulsive-hyperactive types have more overflow and rhythm abnormalities and higher ADHD severity is associated with increased errors.

Conclusions of the study suggest that ADHD children were born term. There is no history of psychiatric disorders or a chronic medical

problem for any children. Neurological soft signs were present in children and also adult and decrease gradually with age. Dysrhythmia and overflows were high in children with ADHD. Co morbid conditions like learning disorder are independent of soft signs and the problems are more with timed and untimed movements

Both types of ADHD children have soft signs especially the hyperactive children has more defects in untimed movements. Limitations of the study were a small sample size, so correlation studies are difficult with this sample size. Also the standards are not given for Indian children.

Fellick et al tried to examine the neurological soft signs and its link with cognition, coordination and behaviour in school children. About 169 children were included in the study from the age 8 to 13 years. Assessment during the study consisted of studying NSS especially six signs. Motor skills are assessed by ABC, cognitive function by WISC-III, and Conner's scale for assessment of behaviour.

Results showed that Children having Neurological soft sign score greater than 90^{th} percentile were said to have an excess of NSS. This excess of ADHD showed 40 percent sensitivity in detecting cognitive function, 45 percent in detecting problems with coordination and 25 percent in detecting ADHD

Conclusion of the study suggests that the children with increased scores for soft signs showed a poor performance in terms of cognition, coordination and behaviour. According to this study NSS is unable to predict the children who are more likely to have a neurological or psychiatric disorder.

Gustafson et al from Sweden tried to study the examination of NSS in ADHD and its reliability, by comparing in children without ADHD, by a physician using DSM-III-R scale.

He examined inter rater reliability, internal consistency, test–retest reliability, and validity. The results suggested the scoring has a good inter rater reliability along with internal consistency. The test–retest study also showed good reliability. The conclusion of the study is that the examination of NSS in ADHD has a good reliability and there is a scope for future research.

Augusto Pasini et al of Rome studied the pathophysiology of Neurological Soft Signs in ADHD. He said that Attention deficit hyperactivity disorder (ADHD) is the most common neurobehavioural disorder.

Inattention, increased activity are said to be common symptoms of ADHD. The association between ADHD and NSS are established. As we have discussed earlier there can’t be particular area of brain responsible

for soft sign. He reviewed all the studies done on ADHD. The change in circuits of the brain that is responsible for control inhibition and dopamine in these circuits are said to be responsible for ADHD in soft sign children.

Daniel P. Dickstein et al compared the neurological evaluation abnormalities in ADHD children and children with bipolar disorder. He performed the Revised Physical and Neurological Examination for Soft Signs (PANESS) in groups of ADHD, bipolar disorder and normal children. Then a physician evaluated there neurological performance. Results showed that children with ADHD showed a defect in the reaction time especially for repetitive tasks. In contrast, paediatric Bipolar disorders children, showed reduced reaction time especially for sequential tasks.

The conclusions of the study showed there is a difference in the pattern of neurological soft signs in children with ADHD, bipolar disorder and normal. ADHD subject's defect is basically in the repetitive tasks so there is a defect in fronto–striato–basal ganglia circuits. In contrast, BPD children shows a defect in sequential tasks which is said to be linked defective attention and learning reversal in bipolar children.

Anne et al from Norway tried to study the motor functions and Neurological Soft Signs to differentiate ADHD from early onset bipolar

disorder. She also tried to investigate whether these differences exist in concurrence with hyperactive children and bipolar children, indicating true co morbidity

Of the 64 children belonging to age 6 to 18 years having the features of ADHD, Bipolar disorder and combined features. They were compared using a standard test for neurological evaluation called NUBU. Chi-square and Fischer exact test were used to analyse the data in case of qualitative variable and Kruskal-Wallis test were used to analyse quantitative data and, if found to be significant, ROC were plotted.

Results suggest that the combined type of ADHD children and children with both Bipolar and hyperactivity showed significant soft signs. NUBU could diagnose combined type of ADHD with positive predictive value of about 90 percent, and it is 86 percent with concurrent BD and it is 87% for bipolar disorder showing defect in static coordination

He concluded that the neurological evaluation test may accurately differentiate from bipolar disorder in clinical paediatrics, and help in evaluating whether symptoms of ADHD with bipolar symptoms show a co morbidity or real overlap

Ferrin et al examined the Neurological Soft Signs as the clinical tool in the diagnosis of ADHD. This explored the relationship between total soft signs and various specific domains in about 1,050 children and adolescents with Attention deficit hyperactive disorder compared to about one hundred thirty children who are normal. Whether the diagnostic capability of NSS is good is detected by plotting ROC

Area under the curves for total soft signs, smoothness of movements with accuracy, imbalance and involuntary movements showed good scores and the results remained same even after matching for both the sex and intelligence of the child. 13 are the score given by the Scored Developmental Neurological Examination (SDNE) to be a limiting diagnostic point to differentiate from ADHD and normal children. The diagnostic capability of NSS in diagnosing ADHD is not fully explained in this study

Waldrop et al studied minor physical anomalies of more than 200 children and analysed various behavioural disturbances. He concluded that the children with a significant Minor Physical Anomalies are said to have greater chances for developing hyperactivity at the age of 3.Jackalin, Mccouby, and Haverston have contradicted that there is no relationship between the subtle morphologic abnormalities and the behaviour of the children

Fogel et al from Denmark tried to find out the relationship between hyperactive behaviour and Minor Physical Anomalies. Minor physical anomalies (MPAs) are primarily due to foetal development causing subtle congenital defects. Both the MPA and central nervous arise from the same ectoderm and this can explain MPA in neurological abnormalities. The present sample of children from Denmark is recruited in longitudinal study. There showed a correlation between hyperactivity in males with MPA and impulsivity in girls with MPA. They can't be used as a screening tool for hyperactivity but this biological evidence can have effect in treatment

Firestone et al published a review article in 1983, regarding the relationship between ADHD and MPA. He reviewed various literatures of minor physical anomalies. The findings for the boys are consistent compared with girls. These boys with ADHD had MPA showed a difference with normal boys. Also there is significant correlation of MPA with intelligence, hyperactivity and school performance. Also, in this study author says that obstetrical complications are associated with minor anomalies.

Gaultier et al published an article saying that the mentally retarded, ADHD and ASD children show an increased frequency of minor physical anomalies suggesting a genetic predisposition and

hypoxia in the intra uterine period. The author's findings are similar to other studies of autistic and hyperactivity children.

Ching and Chang et al did a pilot study trying to find out the relationship between Minor Physical Anomalies in children and future mental problems in adults. Objective of the study is to explore the correlation of early recognizable Minor Physical Anomalies (MPA) during childhood is associated with mental health problems in Young adults. 169 preschool children in central Taiwan underwent a detailed physical examination for MPA. Fourteen years later, the Brief Symptom Rating Scale (BSRS) and Chinese Health Questionnaire (CHQ) were used to measure specific psychiatric symptoms. Results suggest that there is an association between MPA during the childhood and anxiety, whereas depression and paranoid mental health symptoms in the adults. The signs of childhood MPA can be easily identified and should be regarded as risk factors when predicting mental disorder.

Klotz et al studied the relationship between variability in reaction time of the children and motor development. Computerised tasks were performed and reaction times were noted. It is found to be slow for children suffering from ADHD. We know that ADHD children have developmental impairments in motor skills, so we came to a conclusion that this defect in neurological development is due to slow reaction times.

The design of the study is case control study and aim of the study is to find out the link between the motor skills, speed of movement and reaction times with hyperactivity of children. PANESS scale was used for children to assess soft signs in about 35 children from 9 years to 14 years. Reaction times were measured accordingly as described. ADHD children had a reaction time that is slower than that of the normal children. More studies are required to explore the factors responsible for the speed of the movements and slowness of reaction times

Holden et al studied the reliability of Neurological Soft Sign and revaluation of PANESS. He tested the reliability between various observers for a revised version of PANESS. The WISC-R and PANESS were applied to about 30 children of about 8 years old. Retest was done in the same child by other observer after a month. The results of the study showed that the PANESS score is more reliable and even for many observers the retest has no influence on the original score. This PANESS is correlated to the WISC revised version which showed a relationship of brain abnormality and behavioural factors. Further studies are recommended to evaluate the validity and changes in performance score as the result of development is needed

Werry et al studied the reliability and validity of PANESS in evaluation of Neurological Soft Sign. About 20 children with age of

about 8 years were examined by 2 paediatricians, using the scale following the rules and regulations of National Institute of Mental Health

50 percent of the children showed hyperactivity. About 25 percent were normal; other 25 percent children had histories suggestive of insult to the brain. In most children, many of the reliable signs were not seen. Examiners tired to comment the global neurological statuses through these scale. The study concluded by the saying that the unimportant items of the neurological evaluation should be considered as a experimental idea.

Akabaleiv et al published the minor physical anomaly using WALDROP scale in schizophrenic children and tried to investigate the internal consistency of the scale. The study aims at finding out the reliability of the scale in children with schizophrenia. There were about 75 schizophrenic children and 80 normal children who were examined for their anomalies. The correlations are poor for schizophrenic children probably due to differences in location and period of development. The author also tried to study the reliability dependent on sex. There needs to be a more accurate and comprehensive scale that includes all the variants that is possible to provide a reliable assessment of the minor anomaly and to indicate the prenatal period of adverse effects.

Elizabeth Anne et al used Waldrop scale in studying Minor Physical Anomalies in the twin children from five to twelve years. In this study, she tried to determine if the MPA could predict the various behaviour of the children and the most common anomaly for a particular behaviour. She performed a study using Meta analysis from existing literatures between MPA and schizophrenia. The only inclusion criteria were the age of the twin children is from five to twelve years. Two investigators performed the analysis of Minor Physical Anomalies using an expanded version of the scale given by WALDROP. Subset of MPA that is more likely to predict schizophrenia is studied using Meta analysis. Because of the twin children the correlations and heritability of twin pairs were studied. She determined that MPA may not be useful in predicting behavioural variation while it could be used in children with psychiatric disorders especially schizophrenia. This study is considered important because the biological cause for MPA is studied that identifies the risk factors that would help us in early detection.

Martins and Lauterbach did a longitudinal study. He followed 180 children and Neurological Soft Sign improves with age and there is variation in rate of improvement between sexes. Females reach the scores 2 year earlier than corresponding male subgroups

Shafer et al studied the children without focal deficit and followed up for 10 years and tried to study the consistency of neurological signs. About 160 children born in United States were given soft sign scale at age of 7 and they were followed till 17 years and soft signs scales were repeated. The children who had no soft signs were under the control group. Out of the six tests, four tests (dysdiadochokinesis, mirror movements, dysgraphesthesia and motor slowness) results showed in which the index boys showed poor soft signs compared with control boys; whereas, index girls showed poor performance compared with control girls only in motor skills

Clikeman et al studied the Co morbidity between ADHD and learning disability. His results showed there is a considerable overlap between ADHD and LD especially arithmetic form of LD

Mostofsky et al did a case control study of about 40 children with ADHD with age of 8 to 12 years along with 30 children in control group with same age group. There are increased overflow movements in ADHD children when compared to the normal children and ADHD children made more errors especially in motor movements in contralateral side. Overflow movements which are most important clinical manifestations were more in ADHD children. There is a positive correlation of ADHD children with overflow movements compared with normal children helps

in identifying the neural circuits responsible. Thus the hypothesis that overflow movements are due to immature cortical systems was calculated.

Vladimarsdottir of Iceland did a study to find out possible frequency of risk factors in ADHD. Young aged mother at the time of child birth, low birth weight infants and the caesarean section were said to be an important risk factor for ADHD in this study. Maternal alcohol, maternal smoking, birth weight vacuum delivery doesn't cause a much correlation for ADHD in the studies

Shatmari et al studied the overflow movements and behavioural problems. He studied the children from inner city and suburban area and found that suburban children showed more neurological impairment than inner city children. The risk of behaviour problem is high with children with increased degree of brain abnormality comparing to normal children

Piek et al studied the coordination and kinaesthesia in ADHD boys. The results suggested a high percentage of children with ADHD displayed movement difficulties especially coordination difficulties. Children with impulsivity type of ADHD had poor fine motor movements whereas the children with combined type of ADHD showed poor gross

motor movements. More severe the ADHD more will be the motor impairments.

Martha Denkcla studied anomalies of motor development in ADHD children. About 50 boys who had features of ADHD by rating scale but negative for Neurological Soft Signs and Learning disorder are compared with normal children. About eighty nine percent of the children with ADHD showed increased scores for overflow, speed and rhythm. Therefore it is concluded that the boys with ADHD showed poor motor coordination and poor development

Vitiello et al studied the impulsivity and soft neurological signs. The author tried to assess the inter relationship of defect in neurological function and defect in performing tasks. He found that the relationship could not be assessed and he said that the cognitive value should be added for the assessment of impulsivity.

Lazarus et al studied the role of attention in regulating associated movements in children. The study suggests that higher functions like attention and lower functions like cortical inhibition is essential for overflow reduction as the age progresses. The treatment implications are discussed in this study

Mechri et al studied the Neurological Soft Signs in children with schizophrenia and normal siblings. The study concluded that neurological dysfunction is an intrinsic characteristic of the illness and children having reduced motor performance show poor illness course and outcome.

Rigucci et al wanted to know if the Neurological Soft Sign discriminates BD and schizophrenia. Patients suffering from schizophrenia is said to have more neurological deficit when compared to bipolar children the neurology of a child is always closely related to it psychology. The results suggests that the neurological soft signs were able to differentiate between the bipolar children and the schizophrenic children

Bourghou studied the Neurological Soft Signs and their prevalence in children with schizophrenia. The prevalence and NSS scores are high among young people with early onset schizophrenia diagnosis illustrating the existence of structural abnormalities of the brain due to early neurodevelopmental disturbances, which would support the neurodevelopmental hypothesis

Maunolinko et al did a case control study compared the Minor Physical abnormalities in autistic children and control. The results showed that the autistic children show an increase in minor physical

anomalies when compared to the normal children especially in craniofacial region. Also the autistic children have variable ear shapes when compared to normal children. Higher MPA scores were linked with poor cognitive functioning. There is correlation between neurological functioning, autistic children and Minor Physical Anomalies. Minor Physical Anomalies may act as a diagnostic tool for diagnosing various psychiatric disorders.

Compton et al studied the Neurological soft signs and Minor physical anomalies in schizophrenic children, their biological relatives and a group consisting of normal children.Both NSS and MPAs were greater in schizophrenic children when compared to normal children with relatives showing middle scores. Also in all the three groups NSS and MPA scores were not found to be dependent. Patients score is correlated with their relatives score on neurological evaluation scale and minor physical abnormalities especially in eyes and hands. The study showed the association between MPA were not consistent with symptoms. NSS and MPA are two distinct, independent markers of risk of schizophrenia which may help us in arriving at the genetic and environmental factors.

Chan et al studied the neurological soft signs in 1st degree normal siblings of schizophrenic children. Findings show that schizophrenic children along with their relatives show an increased Neurological Soft

Sign when compared to normal children probably accounting for the genetic influences

Akabaleiv et al studied the Minor physical anomalies in children with bipolar disorder and normal children. The bipolar children showed higher levels of anomalies in case of head, mouth, and feet, also in craniofacial region. Statistical significance was noted especially high arched palate, a gap between I and II toes and furrow in the tongue.

Tenyi et al studied the prevalence of Minor Physical Anomalies in children. He studied 57 MPA in 20 autistic children using Maine's scale and found MPA to be strongly positive for autistic children.

Ramveldt et al compared between the computers based testing and behaviour rating scale in diagnosis of ADHD. No significant correlations between these measures were seen. Results suggest that computer-based testing and behavioural ratings cannot be considered equivalent in the assessment of attention and activity among ADHD children.

Zhou et al studied the risk factors for co morbid tic disorder in children with ADHD. The study revealed 6 factors associated with co morbidity: addiction to mobile phone or computer games, poor eating habits, infection, improper family education, poor relationship between parents and poor relationship with schoolmates. Logistic regression

revealed two independent risk factors for co morbidity: improper family education and low socio economic class.

Hubbard et al studied the SPECT imaging differences between ADHD and anxiety disorders. SPECT imaging evidenced that differences exist in Cerebral Blood Flow between hyperactive children and children diagnosed with anxiety when presented with a concentration task. Study showed associations with greater CBF indicating that ADHD children have more active frontal, temporal, parietal, and occipital lobes during concentration than children diagnosed with anxiety in the same brain areas.

Blokhius et al studied the ADHD polygenic risk scores in predicting attention problems in a population based sample. The results indicate genetic overlap between a various risk factors of ADHD and Attention problems scale scores across different raters and various age groups

Chou et al did a population based cohort study between epilepsy and ADHD. This study shows that the association between hyperactivity and epilepsy syndromes were bidirectional. The cause of both hyperactivity and ADHD is said to be common, this implies a common

transcriptional change in the brain responsible for both the seizures and ADHD.

Efron et al did a controlled community study of functional status of children with ADHD. A total of 179 children who have ADHD and 212 non-ADHD controls were recruited in the study. Compared with controls, children who had ADHD have higher odds for externalizing and internalizing disorders, poorer reading, mathematics performance and more peer issues. Boys and girls who had ADHD were equally impaired. Only 17% of children in our ADHD group had been previously diagnosed. Previous diagnosis was higher in the combined group and for boys. In their second year of school, children who had attention deficit hyperactivity disorder performed worse than controls in all functional domains but only a few numbers of children had been formally diagnosed with ADHD. The results suggest the need for earlier diagnosis and intervention.

STUDY JUSTIFICATION

By reviewing various literatures above and through various standard books and journals, it is clear that the children with Neurological Soft Signs and the children with Minor Physical Anomalies are at risk of developing various cognitive problems, learning disabilities, behavioural problems and schizophrenia. These literatures also show that children with neurological soft signs and minor physical anomalies are at risk of developing attention deficit hyperactivity disorder.

Neurological soft sign and Minor Physical Anomaly suggests a diffuse brain injury although specific areas couldn't be localised.NSS and MPA are constant for a person for that age group. The link between neurological soft sign / minor physical anomalies and ADHD suggests diffuse brain injury as a etiologic parameter in ADHD.

Attention Deficit Hyperactivity Disorder is a neurobiological disorder. The aetiology of ADHD is primarily genetic. The siblings share a common genetic pattern as that of ADHD. Studying the Neurological Soft Signs and Minor Physical Anomalies in siblings of ADHD we could be able to reason out the genes and its correlation with the region of brain involved in this disorder.

In future the siblings of ADHD could be screened from an earlier age for various outcomes in adults like hyperactivity, cognitive

dysfunction, behavioural disturbance like autism, mental disorders like bipolar disorder and schizophrenia.

Also there is a scope for assessing neurological soft sign and minor physical anomaly as a screening tool for various behavioural and psychiatric problems in near future. At the most, an imaging modality can be developed to quantitate the diffuse brain injury in near future so that later possibility of ADHD and other disorders could be identified earlier.

AIMS AND OBJECTIVES

AIM OF THE STUDY

To study the Neurological Soft Signs and Minor Physical Anomalies in siblings of ADHD children in comparison with normal controls.

OBJECTIVES

1. To compare the Neurological Soft Signs and Minor Physical Anomalies in ADHD siblings and age matched controls
2. To study the correlation between Neurological Soft Signs and Minor Physical Anomalies.
3. To study the gender difference in Neurological Soft Signs and Minor Physical Anomalies.
4. To study the correlation between Neurological Soft Signs and the socioeconomic class the child
5. To study the correlation between Minor Physical Anomalies and socioeconomic class of the child

HYPOTHESIS

Null hypothesis is assumed in this study that is ($p < 0.05$)

1. Neurological Soft Signs and Minor Physical Anomalies between ADHD siblings and age matched controls are considered equal.
2. There is no correlation between Neurological Soft Sign and Minor Physical Anomaly.
3. There is no difference between males and females in Neurological Soft Signs and Minor Physical Anomalies
4. Socioeconomic class of the child is unrelated to Neurological Soft Sign and Minor Physical Anomaly.

SUBJECTS AND METHODS

Subjects and Methods

The design of the study is a case control study. The study was conducted in ICH & HC. The study population consists of children from age 8 to 13 years. The ethical committee approval was obtained from Ethical committee of Madras Medical College on April 2014. The study period consists of 4 months from May 2014 to August 2014.

All the children who are newly diagnosed of ADHD in child Psychiatry department during the study period were included in the study.

There were about 154 newly diagnosed ADHD children during the study period. Of that 96 children had siblings from 8 to 13 years. Of the 96 siblings 28 children fulfilled the criteria for ADHD and were excluded from the study.

Of the remaining 68 children 7 children had seizure disorder or neurological problem.2 children had a family history of psychiatric disorder and 2 children failed to give consent for the study. The remaining 57 children were included in the study. None of the children included in the study were eliminated during the study.

Similarly control group was selected from the children of age 8 to 13 years from immunization clinic and general op who has come for

minor illness during July and August 2014 .First 57 children who were negative for ADHD as per DSM-IV criteria, who doesn't have a gross neurological deficit or a psychiatric disorder, who doesn't have a family history of schizophrenia are included in this study.

INCLUSION AND EXCLUSION CRITERIA

For Cases

1. The children should be a sibling of an ADHD child.
2. The age of the child must be from 8 to 13 years.
3. The child should not show features of ADHD or any other psychiatric disorder.
4. The child should not show any signs of gross neurological disorder or seizures in the past.
5. The child should not have a family history of schizophrenia.

For Controls

1. The child should be from age 8 to 13 years.
2. The child should not show features of ADHD or any other psychiatric disorder.
3. The child should not have any features of gross neurological deficit.
4. The child should not have a family history of schizophrenia.

METHODOLOGY

The number of subjects from both case and control group were 57 each. Case group consists of children between age groups 8- 13 who are a sibling of children newly diagnosed of ADHD during the study period of 4 months (May 2014 to August 2014).

Subjects included in the study are then given PANESS scale for Neurological Soft Signs and WALDROP scale for Minor Physical Anomalies. Similarly subjects in control group falling in age group from 8-13 years who were negative for DSM –IV criteria are included in this study. These children are then administered PANESS for Neurological soft signs and WALDROP for Minor Physical Anomalies

The results of both the groups are compared and statistical significance if at all any is identified

INTRODUCTION TO PANESS

Revised Physical and Neurological Evaluation of Soft Signs (PANESS) were first given by Martha Denckla in 1983.This scored examination scale helps in examiner to have an objective evidence of determining soft signs .The examiner need not be a physician all the times and should tell and also demonstrate each and every items. The test usually takes about 20 to 25 minutes. Each and every child should be given identical instruction using a routine set of questions at the

beginning of testing, the child is asked to pay attention to instruction, asks the child to watch carefully and repeat what the instructor does. Most of the items in the study require stop watch, so kindly instruct the child not to start until the examiner says start. Immediately after describing and demonstrating each task ask the child to repeat. Most important of this scale lies in the proper instruction and clear demonstration. The examination is supported by verbal praise and constant encouragement and motivation.

Materials and Equipment

The room should be well lighted, with no noise and should be free from other disturbances. Items required for the study are a stopwatch for the examiner, a chair for the patient to sit, a table or a desk. Adhesive tape, 1 ½ inches in width, and 6 foot in length, and a big room without any obstructions. Linoleum tiled square floor is acceptable Administration of the scale and scoring are given at the end of the study

Coding instructions and the PANESS sheet is given at the annexure.

WALDROP MINOR PHYSICAL ANOMALY SCALE

Minor physical anomalies are evaluated by WALDROP Minor Physical Anomalies score

It consists of 4 important headings namely

1. Head
2. Mouth
3. Hands
4. Feet

The maximum number of score that one can obtain in minor physical anomalies is 18 and minimum number of score could be zero.

These are the objective evidence of subtle minor physical anomalies

The anomalies of the head are further divided into

1. Head
2. Eyes
3. Ears

Minor Physical Anomalies included in head includes head circumference and hair and its consistency whether is soft, fine, brittle, curly.

The maximum score of 2 is given for certain items like head circumference >1.5 S.D.

Deeply covered epicanthus, bottom of the ears in line with lower mouth, lower edges of ear upward and back towards crown of head, steepled roof of mouth, markedly curved inwards towards other fingers and third toe definitely longer than 2nd toe.

All other items have a score of one. When there is no such even a slightest of the anomaly the score is given as zero.

The exact items along with the scoring are given in the annexure.

STATISTICAL ANALYSIS

Data are collected and continuous variable (over flow items, total PANESS, Minor physical anomalies) between cases and control was recorded. To find out the significant difference between in Neurological Soft Signs and Minor Physical Anomalies, standard deviation (SD), mean (x) and standard error (SE) was calculated for each group. Null hypothesis was assumed (Neurological Soft Signs and Minor Physical Anomalies were equal among both groups). Independent t test were applied to compare the mean between the two groups

The SD was compared by calculating F and assuming a 95% confidence interval (95%). 2-tailed method is used to find out the statistical significance. The p value of < 0.05 is considered significant. Also frequency tables for age and gender are plotted using graphs and bars .And if any age and gender variation if at all present is identified.

Correlations are established between Neurological Soft Signs and Minor Physical Anomalies. Socioeconomic classes were correlated with Neurological Soft Signs and Minor Physical Anomalies using Pearson's correlation

All analysis are performed using SPSS software (statistical package for social sciences) version 17.0

RESULTS

Total number of children in case group - 57

(ADHD sibling)

Total number of children in control group - 57

(Normal controls)

The age of study is from 8 to 13 years of age

No children were excluded during the study

Males - 74

Females - 40

The results of the analysis are tabulated below

Total number of children included in the study is 114. And no children were missing or disqualified during the study.

SEX

Table : 1

N	Valid	114
	Missing	0

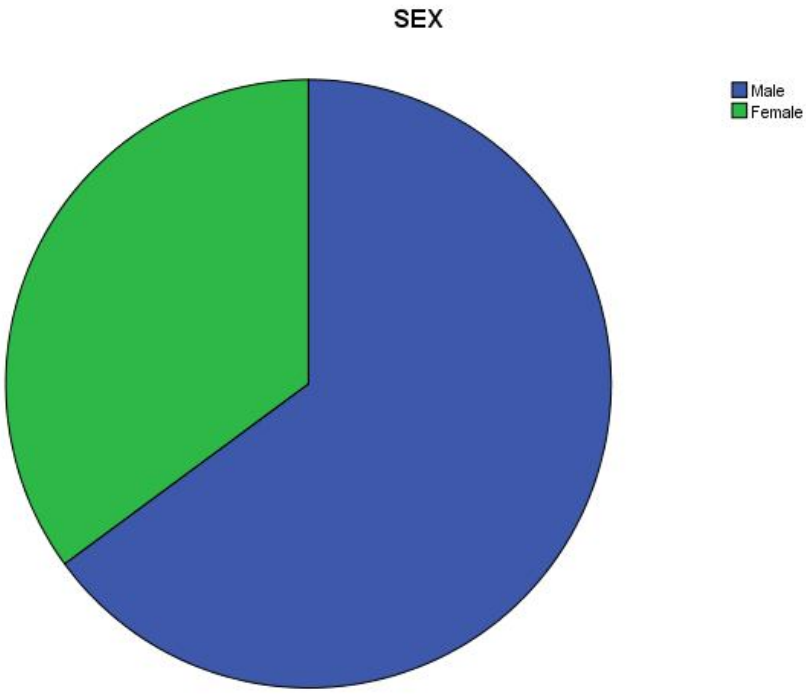
SEX FREQUENCY

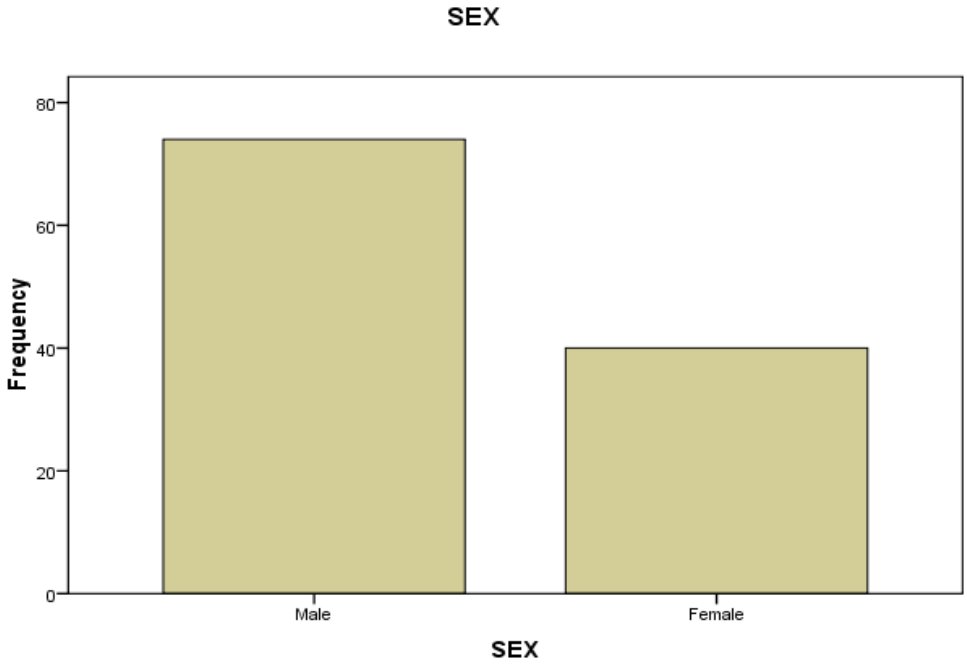
Table : 2

Sex	Frequency	Percent	Valid Percent	Cumulative Percent
Male	74	64.9	64.9	64.9
Female	40	35.1	35.1	100.0
Total	**114**	**100.0**	**100.0**	

The total number of males in both case and control group are 74 which is 64.9 % and total Number of females in both case and control group are 40 which accounts for 35.1%.

The number of males is almost twice that of the females included in the study. The frequency is drawn in a bar diagram given below.



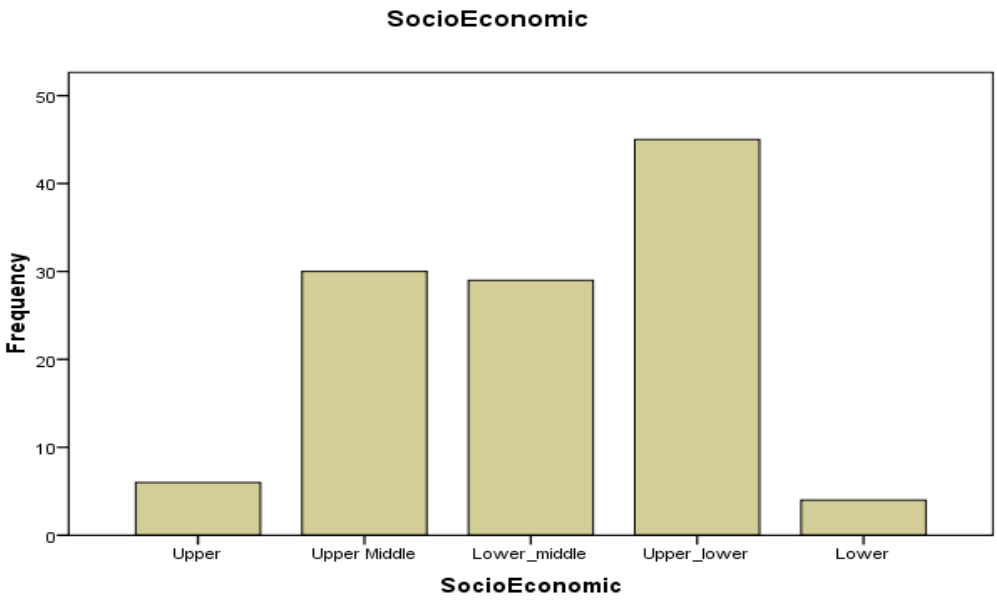


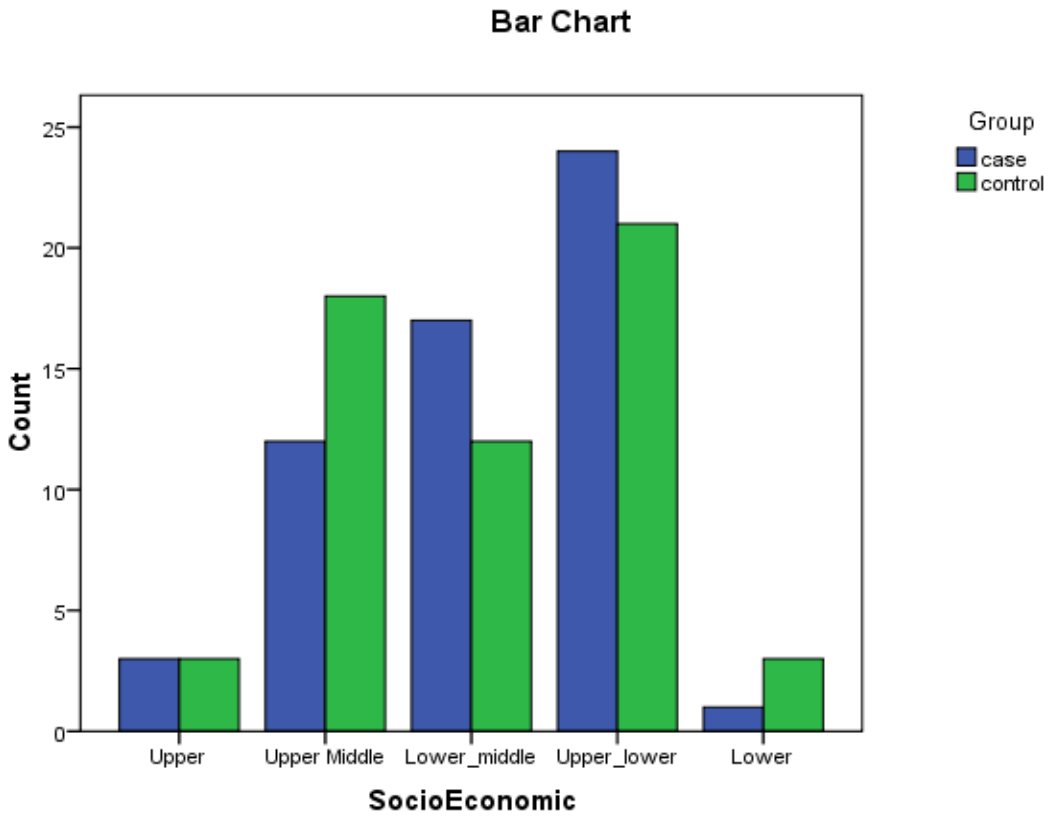
Socio Economic Classes

Table : 3

Socio Economic Classes	Frequency	Percent	Valid Percent	Cumulative Percent
Upper	6	5.3	5.3	5.3
Upper Middle	30	26.3	26.3	31.6
Lower Middle	29	25.4	25.4	57.0
Upper Lower	45	39.5	39.5	96.5
Lower	4	3.5	3.5	100.0
Total	**114**	**100.0**	**100.0**	

The children included in the study are classified into 5 groups based on socio-economic class (Modified Kuppusamy Scale). The number of children included in the upper class (Class 1) is 6 and in the upper middle class (Class 2) 30, lower middle class (Class 3) is 29, upper lower class (Class 4) is 45, lower class (Class 5) is 4.





The number of children in each socio-economic class for both case and control group were given

Table : 4

Socio Economic Classes	Group		Total
	Case	Control	
Upper	3	3	6
Upper Middle	12	18	30
Lower Middle	17	12	29
Upper Lower	24	21	45
Lower	1	3	4
Total	**57**	**57**	**114**

The number of persons in all the classes for both the groups were compared in the bar chart and the number of children in each class is almost equal except for the upper middle class which is 12 in case and 18 in the control and the lower middle class which is 17 in case and 12 in control.

Group Statistics

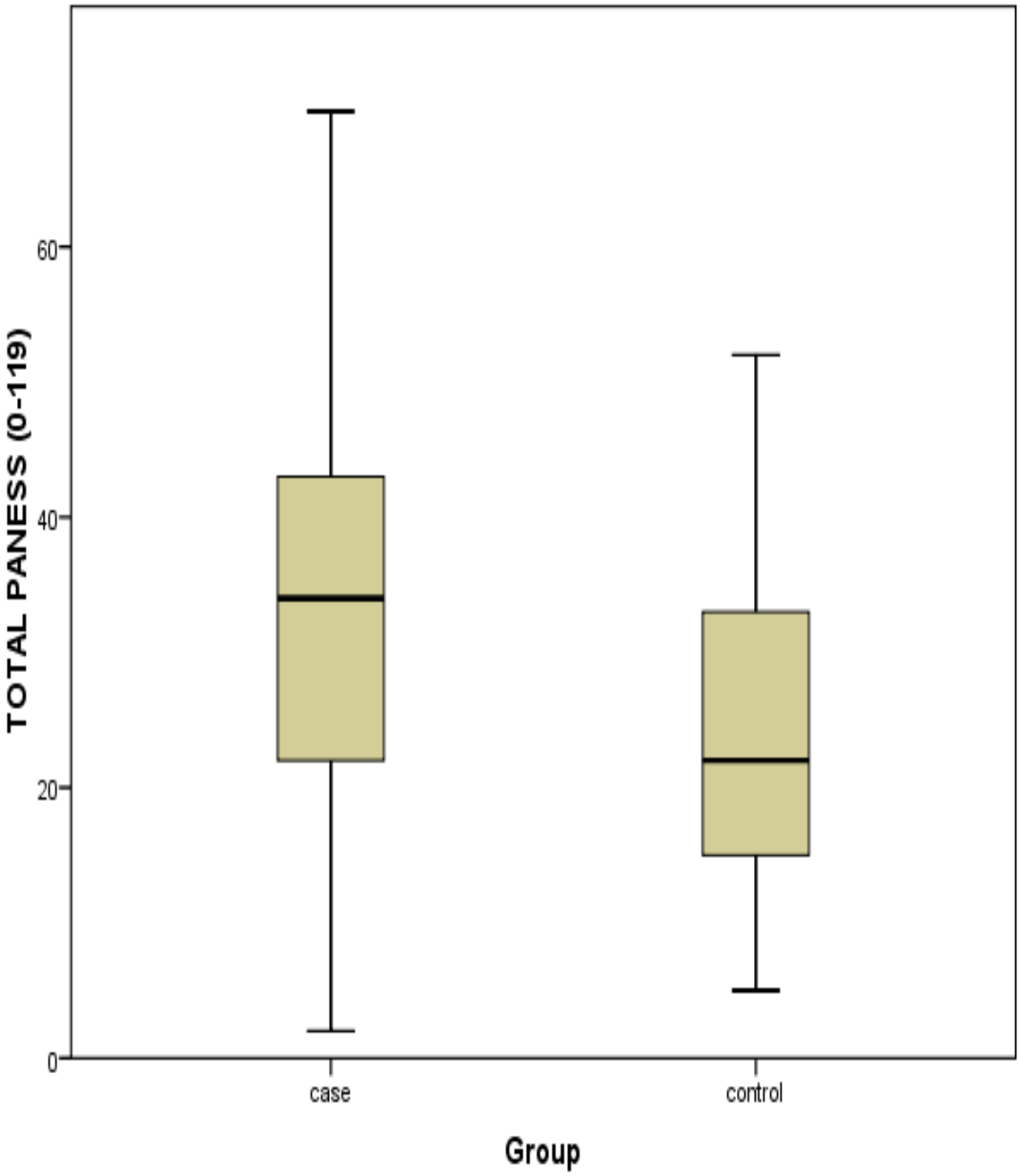
Table : 5

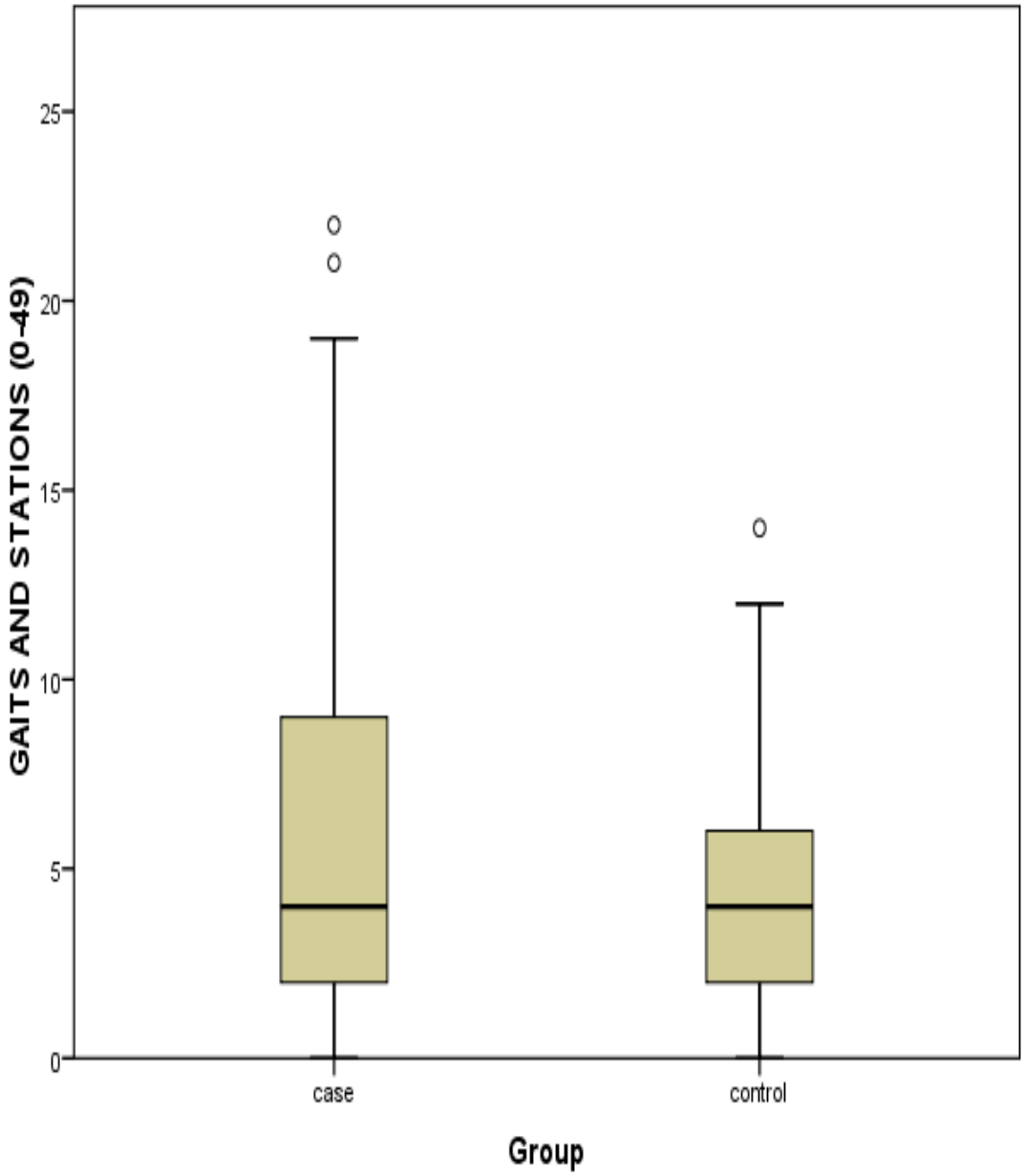
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
OVERFLOW (0-31)	3.332	112	.001	3.456	1.037
	3.332	110.542	.001	3.456	1.037
GAITS AND STATIONS (0-49)	3.332	110.542	.001	3.456	1.037
	2.376	112	.019	2.088	.879
TOTAL TIMED (0-70)	2.376	92.768	.020	2.088	.879
	4.031	112	.000	7.877	1.954
TOTAL PANESS (0-119)	4.031	110.579	.000	7.877	1.954
	3.977	112	.000	9.842	2.475
MPA SCALE (0-18)	3.977	108.011	.000	9.842	2.475
	.791	112	.431	.281	.355
AGE	.791	106.340	.431	.281	.355
	control	57	10.33	1.585	.210

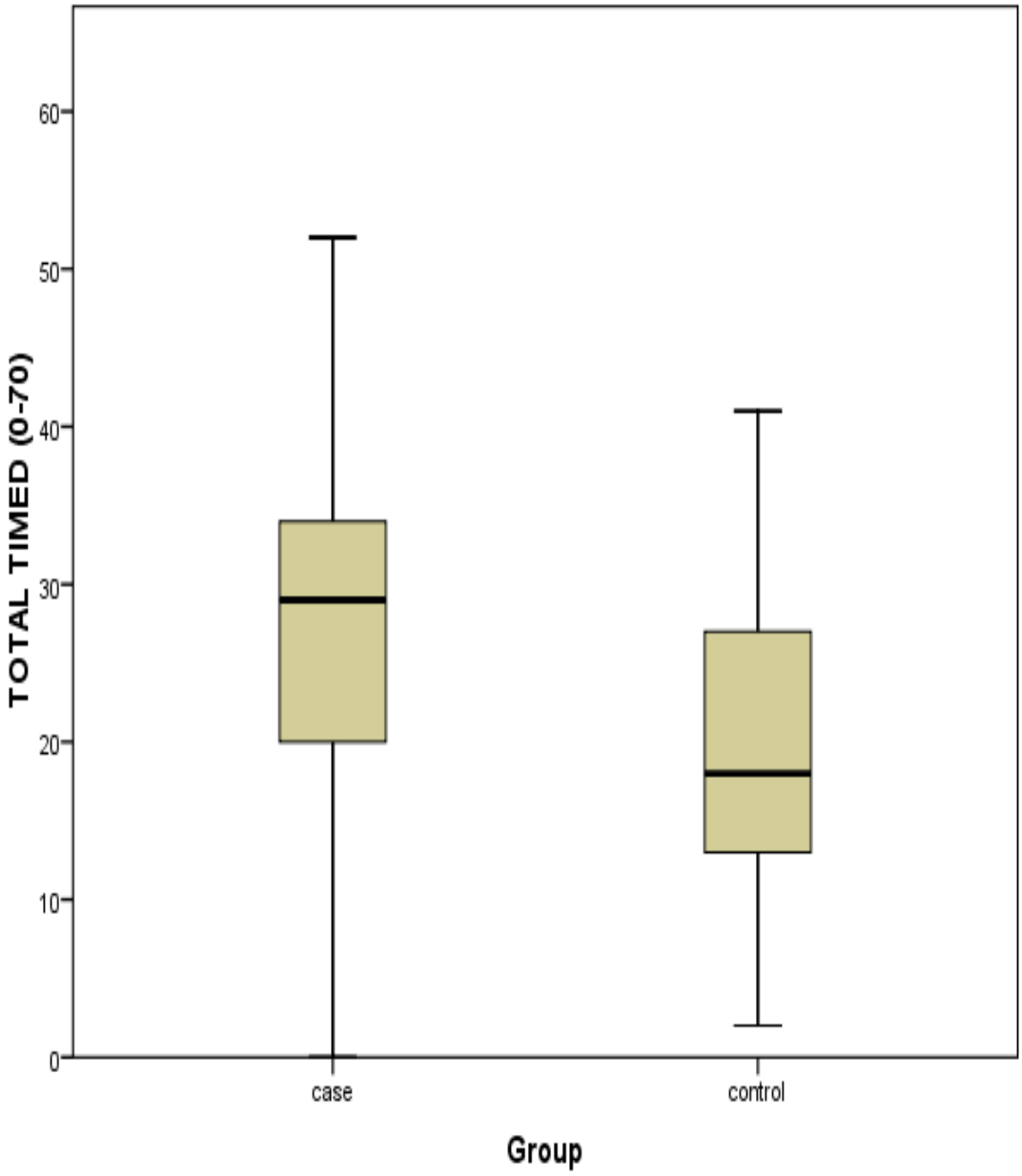
The mean, standard deviation and standard error mean is calculated for all the variables. The independent t-Test is applied and the data in both the groups are statistically compared and statistical difference noted.

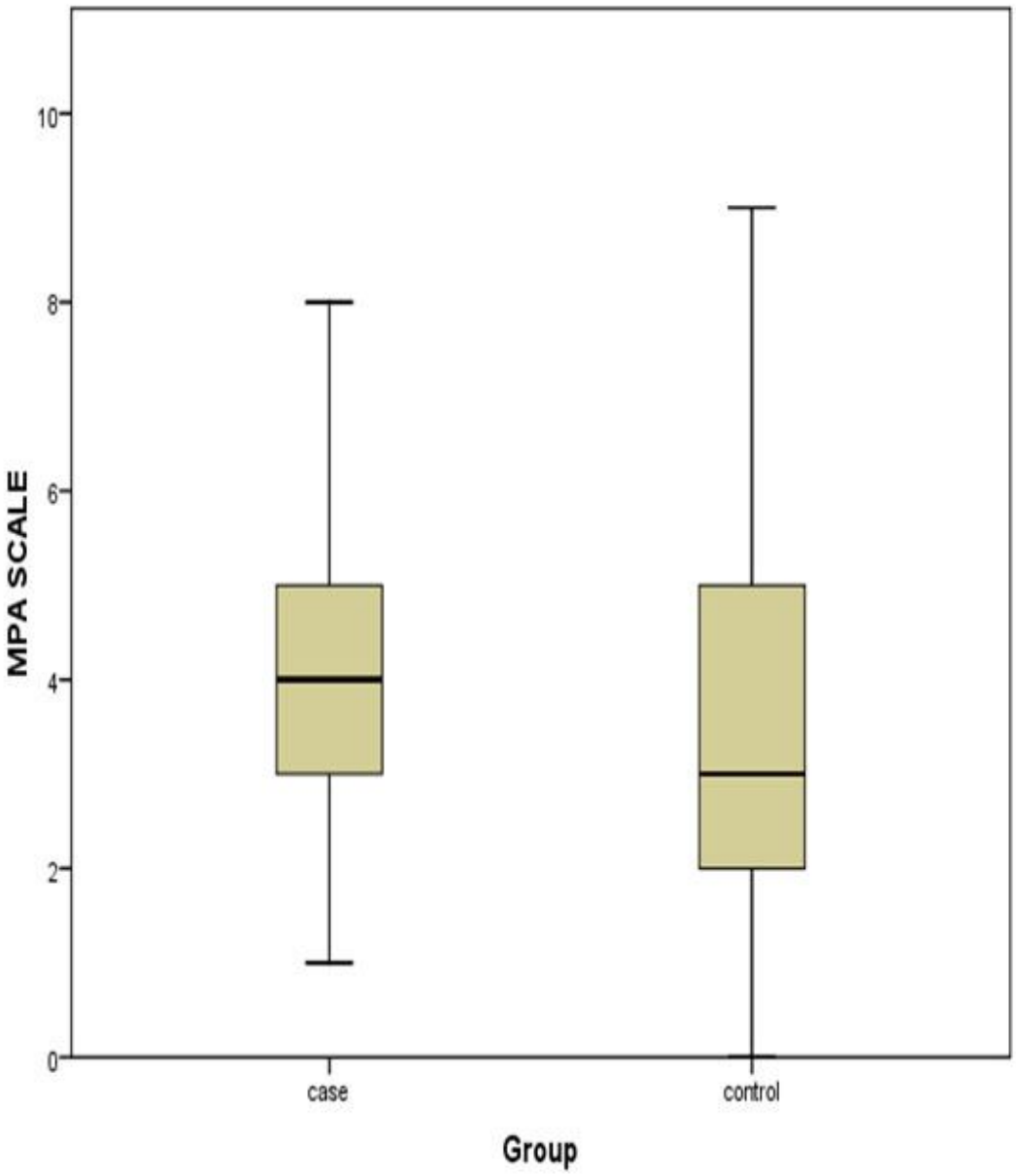
The difference in overflow items in two groups is statistically significant ($p < 0.05$). The difference in gait and stations in two groups is statistically significant ($p < 0.05$). The difference in total timed in two groups is statistically significant ($p < 0.05$). The difference in total PANESS in two groups is statistically significant ($p < 0.05$). The difference in MPA scale is not significant between two groups.

Interactive graphs were shown comparing the variables like overflow, gaits and stations, total timed, total PANESS, MPA scale individually between case and control.


TOTAL PANESS (0-119)
60
40
20
0
case
control
Group


GAITS AND STATIONS (0-49)
25
20
15
10
5
0
case
control
Group


TOTAL TIMED (0-70)
60
50
40
30
20
10
0
case
control
Group


MPA SCALE
10
8
6
4
2
0
case
control
Group

Independent t-Test was individually applied for males and females for both groups separately. The results are given below.

Group Statistics (Case)

Table : 6

Variables	Sex	N	Mean	Std. Deviation	Std. Error Mean
OVERFLOW (0-31)	Male	38	11.24	5.533	.898
	Female	19	10.26	6.539	1.500
GAITS AND STATIONS (0-49)	Male	38	6.97	6.197	1.005
	Female	19	5.11	4.267	.979
TOTAL TIMED (0-70)	Male	38	27.42	11.222	1.820
	Female	19	27.89	10.862	2.492
TOTAL PANESS (0-119)	Male	38	34.47	14.921	2.420
	Female	19	33.00	13.715	3.147
MPA SCALE (0-18)	Male	38	3.92	1.792	.291
	Female	19	3.89	1.410	.323

Independent Sample Test (Case)

Table : 7

	t-test for Equality of Means		
	T	**df**	**Sig. (2-tailed)**
OVERFLOW (0-31)	.589	55	.558
	.557	31.247	.582
GAITS AND STATIONS (0-49)	1.179	55	.243
	1.331	49.305	.189
TOTAL TIMED (0-70)	-.152	55	.880
	-.153	37.185	.879
TOTAL PANESS (0-119)	.361	55	.720
	.371	38.968	.712
MPA SCALE (0-18)	.056	55	.956
	.061	44.637	.952

In case group, the difference in males and females were not statistically significant in overflow, gait and stations, total timed, total PANESS and MPA Scale.

Group Statistics (Control)

Table : 8

	Sex	N	Mean	Std. Deviation	Std. Error Mean
OVERFLOW (0-31)	Male	36	7.22	5.083	.847
	Female	21	7.86	5.525	1.206
GAITS AND STATIONS (0-49)	Male	36	4.22	3.235	.539
	Female	21	4.33	3.903	.852
TOTAL TIMED (0-70)	Male	36	18.50	10.227	1.705
	Female	21	21.76	8.949	1.953
TOTAL PANESS (0-119)	Male	36	23.33	12.786	2.131
	Female	21	25.52	10.269	2.241
MPA SCALE (0-18)	Male	36	3.72	2.337	.390
	Female	21	3.48	1.662	.363

Independent Sample Test (Control)

Table : 9

	t-test for Equality of Means		
	t	**df**	**Sig. (2-tailed)**
OVERFLOW (0-31)	-.441	55	.661
	-.431	39.166	.669
GAITS AND STATIONS (0-49)	-.116	55	.908
	-.110	35.941	.913
TOTAL TIMED (0-70)	-1.214	55	.230
	-1.258	46.620	.215
TOTAL PANESS (0-119)	-.669	55	.507
	-.708	49.429	.482
MPA SCALE (0-18)	.423	55	.674
	.462	52.694	.646

In control group, the difference in males and females were not statistically significant in overflow, gait and stations, total timed, total PANESS and MPA Scale.

Correlations

The correlations between overflow, gaits and stations, Total Timed, Total PANESS are compared with MPA scale in case group and correlations were noted between overflow and MPA scale (Pearson Correlation 0.323) and correlations were noted between timed and MPA scale (Pearson Correlation 0.462). For no other variables, correlations were noted for MPA scale.

Table : 10 (Case Group)

		TOTAL PANESS (0-119)	**MPA SCALE (0-18)**
OVERFLOW (0-31)	Pearson Correlation	.805**	.323*
	Sig. (2-tailed)	.000	.014
	N	57	57
GAITS AND STATIONS (0-49)	Pearson Correlation	.729**	.229
	Sig. (2-tailed)	.000	.086
	N	57	57
TOTAL TIMED (0-70)	Pearson Correlation	.933**	.462**
	Sig. (2-tailed)	.000	.000
	N	57	57
TOTAL PANESS (0-119)	Pearson Correlation	1	.444**
	Sig. (2-tailed)		.001
	N	57	57
MPA SCALE (0-18)	Pearson Correlation	.444**	1
	Sig. (2-tailed)	.001	
	N	57	57

Table : 11 (Control Group)

		TOTAL PANESS (0-119)	**MPA SCALE (0-18)**
OVERFLOW (0-31)	Pearson Correlation	.817**	.210
	Sig. (2-tailed)	.000	.117
	N	57	57
GAITS AND STATIONS (0-49)	Pearson Correlation	.501**	.085
	Sig. (2-tailed)	.000	.531
	N	57	57
TOTAL TIMED (0-70)	Pearson Correlation	.906**	.209
	Sig. (2-tailed)	.000	.118
	N	57	57
TOTAL PANESS (0-119)	Pearson Correlation	1	.305*
	Sig. (2-tailed)		.021
	N	57	57
MPA SCALE (0-18)	Pearson Correlation	.305*	1
	Sig. (2-tailed)	.021	
	N	57	57

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

Group = Control

In control group, correlations were noted between total PANESS and MPA Scale (Pearson Correlation 0.305). For no other variables, correlations were noted.

In case group, the correlations between overflow, gaits and stations, total timed and total PANESS were compared with the socio-economic classes and no positive correlations were noted

Table : 12 (Case Group)

		Socio Economic
OVERFLOW (0-31)	Correlation Coefficient	.008
	Sig. (2-tailed)	.952
	N	57
GAITS AND STATIONS (0-49)	Correlation Coefficient	.071
	Sig. (2-tailed)	.602
	N	57
TOTAL TIMED (0-70)	Correlation Coefficient	.171
	Sig. (2-tailed)	.203
	N	57
TOTAL PANESS (0-119)	Correlation Coefficient	.148
	Sig. (2-tailed)	.271
	N	57
MPA SCALE (0-18)	Correlation Coefficient	-.068
	Sig. (2-tailed)	.615
	N	57
SOCIO ECONOMIC	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	57

Table : 13 (Control Group)

		Socio Economic
OVERFLOW (0-31)	Correlation Coefficient	.202
	Sig. (2-tailed)	.132
	N	57
GAITS AND STATIONS (0-49)	Correlation Coefficient	-.045
	Sig. (2-tailed)	.741
	N	57
TOTAL TIMED (0-70)	Correlation Coefficient	.113
	Sig. (2-tailed)	.404
	N	57
TOTAL PANESS (0-119)	Correlation Coefficient	.081
	Sig. (2-tailed)	.549
	N	57
MPA SCALE (0-18)	Correlation Coefficient	.179
	Sig. (2-tailed)	.182
	N	57

In control group, the correlations between overflow, gaits and stations, total timed, Total PANESS and socioeconomic class were studied. And no positive correlations were noted.

Correlations

Correlations are drawn each socio economic class for various items of PANESS with total PANESS and MPA scale for case and control group.

Table : 14

		TOTAL PANESS (0-119)	**MPA SCALE (0-18)**
OVERFLOW (0-31)	Correlation Coefficient	1.000**	.000
	Sig. (2-tailed)	.	1.000
	N	3	3
GAITS AND STATIONS (0-49)	Correlation Coefficient	.866	.500
	Sig. (2-tailed)	.333	.667
	N	3	3
TOTAL TIMED (0-70)	Correlation Coefficient	.866	-.500
	Sig. (2-tailed)	.333	.667
	N	3	3
TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.000
	Sig. (2-tailed)	.	1.000
	N	3	3
MPA SCALE (0-18)	Correlation Coefficient	.000	1.000
	Sig. (2-tailed)	1.000	.
	N	3	3

**. Correlation is significant at the 0.01 level (2-tailed). Group = case, SocioEconomic = Upper

Table : 15

		TOTAL PANESS (0-119)	MPA SCALE (0-18)
OVERFLOW (0-31)	Correlation Coefficient	.719**	.462
	Sig. (2-tailed)	.008	.131
	N	12	12
GAITS AND STATIONS (0-49)	Correlation Coefficient	.506	.238
	Sig. (2-tailed)	.093	.457
	N	12	12
TOTAL TIMED (0-70)	Correlation Coefficient	.984**	.515
	Sig. (2-tailed)	.000	.086
	N	12	12
TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.459
	Sig. (2-tailed)	.	.134
	N	12	12
MPA SCALE (0-18)	Correlation Coefficient	.459	1.000
	Sig. (2-tailed)	.134	.
	N	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

a. Group = case, SocioEconomic = Upper Middle

Table : 16

		TOTAL PANESS (0-119)	MPA SCALE (0-18)
OVERFLOW (0-31)	Correlation Coefficient	.847**	.566*
	Sig. (2-tailed)	.000	.018
	N	17	17
GAITS AND STATIONS (0-49)	Correlation Coefficient	.715**	.761**
	Sig. (2-tailed)	.001	.000
	N	17	17
TOTAL TIMED (0-70)	Correlation Coefficient	.926**	.488*
	Sig. (2-tailed)	.000	.047
	N	17	17
TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.596*
	Sig. (2-tailed)	.	.012
	N	17	17
MPA SCALE (0-18)	Correlation Coefficient	.596*	1.000
	Sig. (2-tailed)	.012	.
	N	17	17

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Group = Case, Socio Economic = Lower middle

Table : 17

			TOTAL PANESS (0-119)	MPA SCALE (0-18)
	OVERFLOW (0-31)	Correlation Coefficient	.772**	-.110
		Sig. (2-tailed)	.000	.608
		N	24	24
	GAITS AND STATIONS (0-49)	Correlation Coefficient	.619**	-.296
		Sig. (2-tailed)	.001	.160
		N	24	24
	TOTAL TIMED (0-70)	Correlation Coefficient	.863**	.409*
		Sig. (2-tailed)	.000	.047
		N	24	24
	TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.182
		Sig. (2-tailed)	.	.394
		N	24	24
	MPA SCALE (0-18)	Correlation Coefficient	.182	1.000
		Sig. (2-tailed)	.394	.
		N	24	24

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Group = case, Socioeconomic = Upper lower

Significant correlations are seen in the case group for lower middle class with overflow items, gaits and stations, total timed and total PANESS with minor physical anomalies. Also significant correlations are seen with total timed and minor physical anomalies in upper lower socioeconomic group. In other classes no significant correlations were seen. We had a significantly low number of lower socioeconomic groups. Correlations were not drawn for this group.

Table : 18

		TOTAL PANESS (0-119)	MPA SCALE (0-18)
OVERFLOW (0-31)	Correlation Coefficient	.812**	.095
	Sig. (2-tailed)	.000	.707
	N	18	18
GAITS AND STATIONS (0-49)	Correlation Coefficient	.585*	.356
	Sig. (2-tailed)	.011	.148
	N	18	18
TOTAL TIMED (0-70)	Correlation Coefficient	.967**	.204
	Sig. (2-tailed)	.000	.417
	N	18	18
TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.279
	Sig. (2-tailed)	.	.263
	N	18	18
MPA SCALE (0-18)	Correlation Coefficient	.279	1.000
	Sig. (2-tailed)	.263	.
	N	18	18

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Group= Control, Socioeconomic= Upper Middle

Table :19

		TOTAL PANESS (0-119)	MPA SCALE (0-18)
OVERFLOW (0-31)	Correlation Coefficient	.858**	.571
	Sig. (2-tailed)	.000	.052
	N	12	12
GAITS AND STATIONS (0-49)	Correlation Coefficient	.512	.000
	Sig. (2-tailed)	.089	1.000
	N	12	12
TOTAL TIMED (0-70)	Correlation Coefficient	.795**	.345
	Sig. (2-tailed)	.002	.272
	N	12	12
TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.592*
	Sig. (2-tailed)	.	.043
	N	12	12
MPA SCALE (0-18)	Correlation Coefficient	.592*	1.000
	Sig. (2-tailed)	.043	.
	N	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Group = control, Socioeconomic = Lower middle

Table :20

		TOTAL PANESS (0-119)	MPA SCALE (0-18)
OVERFLOW (0-31)	Correlation Coefficient	.766**	.063
	Sig. (2-tailed)	.000	.786
	N	21	21
GAITS AND STATIONS (0-49)	Correlation Coefficient	.353	.123
	Sig. (2-tailed)	.116	.596
	N	21	21
TOTAL TIMED (0-70)	Correlation Coefficient	.962**	.259
	Sig. (2-tailed)	.000	.256
	N	21	21
TOTAL PANESS (0-119)	Correlation Coefficient	1.000	.290
	Sig. (2-tailed)	.	.202
	N	21	21
MPA SCALE (0-18)	Correlation Coefficient	.290	1.000
	Sig. (2-tailed)	.202	.
	N	21	21

**. Correlation is significant at the 0.01 level (2-tailed). Group = control, Socioeconomic = Upper lower

Similarly correlations were drawn for control group for each socioeconomic Class for overflow items, gaits and stations, total timed and total PANESS No significant correlations were noted in most of the items and correlations are noted for total PANESS and MPA scale in lower middle class. This correlation probably could be by chance.

DISCUSSION

Although much of the knowledge about the attention deficit and hyperactivity disorder is from research material, there is a rapid growth of understanding of the research in adults also. There are various studies regarding aetiology, clinical features and treatment issues for attention deficit hyperactivity disorder in children. It is being discovered that adults and children with ADHD share similar clinical symptoms, co-morbidities and difficulties in major life domains like work and academics and similar brain abnormalities (Seidman et. al). It has become clear that for a gain of full understanding of ADHD, the disorder must be studied from a lifespan perspective integrating what is known about and how much impact it is going to have on adults and children

Of the 114 children recruited for the study in the case-control format, 74 are males and 40 are females. All the ADHD children newly diagnosed during the study period. The siblings of these ADHD children falling under the age group from 8 to 14 years were given DSM-IV criteria. The siblings who were all negative for ADHD as per DSM-IV criteria are included in the study as the control group. Other group consists of normal children negative for any neurological and psychiatric problems with negative family history of neurological disorders. They form the age matched control groups.

Diagnostic and Statistical manual of mental disorders

The Diagnostic and Statistical manual of mental disorders 4th edition is the first to acknowledge that full-fledged ADHD can persist into adulthood. This edition states that the symptoms of ADHD gradually reduce during the adolescent and adulthood. Still there are few children who start having ADHD symptoms after adolescent period. It is very common that most of the the children with ADHD shows continued presentation into adulthood. Adult onset ADHD cannot be a valid diagnosis according to DSM-IV criteria. The definition states that, ADHD must always begin in childhood and evidence of that must be seen before age of 7. Another change in the fourth edition was placing of hyperactive and impulsivity symptoms in the same list but keeping them separate. A distinction also was drawn between inattentive symptoms and other symptom clusters. Although both DSM-III-R and DSM-IV acknowledge that symptoms persist into adulthood into many people who are diagnosed as children both editions describe symptoms much more in terms of a child's experience than that of the adult.

Diagnostic and Statistical manual of mental disorders 4th edition, text revision (DSM-IV-TR) outlines three major criteria for making ADHD diagnosis. Moderate severity ratings for at least 6 of the total 9 symptoms of inattention or hyperactivity, 2 settings impairment

being work or school or home and symptoms dating back to early childhood.

As DSM-IV criteria now stand, of the 9 symptoms atleast 6 must be present in the inattention category for the inattentive sub-type diagnosis. Of the 9 symptoms at least 6 must be present in hyperactivity and impulsive category for the hyperactive/impulsive subtype diagnosis and of the 9 symptoms 6 must be present for both of the other 2 subtypes for a combined subtype diagnosis. In a recent clinical study, 25% of the patients had inattentive subtype, 5% were predominantly hyperactive and 70% had a combined subtype. In another clinical trial, the combined type was found to be predominant by a retrospective study; the inattentive subtype was equally represented as predominant subtype in the current diagnosis. This reflects a disproportionate loss of hyperactive/impulsive symptoms with age. Rating scales are used in assessing current symptoms. In terms of diagnosis and severity assessment the use of the 18 core symptoms by DSM-IV criteria has been accepted as valid and reliable.

DSM-IV criteria is employed in this study for both case and control for the diagnosis of ADHD and at least 6 of 9 symptoms of inattention and at least 6 of 9 hyperactive or impulsive symptoms were looked for. The previously diagnosed ADHD children were included in the study that

were on follow up and on drug treatment were not included in the study. The siblings of all newly diagnosed ADHD children during the study group and the age matched normal controls in the age group of 8 to 14 years were given DSM-IV criteria during the study.

Socio Economic Influences

Russell et al in his study suggested that Neurological Soft Sign is dependent on family income, psychiatry disorders and age. The result of his study suggested that the Neurological Soft Signs in ADHD is more prevalent among lower socio-economic groups. Although many other clinical trials do not have a significant contribution of socio-economic status for neurological soft signs in ADHD. Many clinical trials (law et. al, Marten et. al.) showed the socio-economic status is independent of neurological soft status, but it depends on the aetiology especially anti-natal care, smoking, alcohol and drug usage. Socio-economic status also influences the treatment outcome and follows up of the children with ADHD.

In our study, the 114 children were classified into 5 groups based on their socio-economic status by modified Kuppusamy scale. Each child was allotted one class based on their family income, education and occupation. The socio-economic classes were compared between two groups. Although the proportion of the upper (Class 1) and lower (Class

5) were less in both the groups, they were comparable in both groups. The upper middle class (Class 2), lower middle class (Class 3) and upper lower class (Class 4) forms the major class of our study in both case and control group. So if at all there are any influences in the Neurological Soft Signs because of the socio economic status, it is matched in both the case and control groups.

The socio-economic classes were obtained through interviews with father and mother or either of the one whose reliability is considered good. Three children whose mother and father were absent during the study, presenting to our clinic with caretakers were asked to bring the mother and father another day to find out the exact socio-economic status of the parents. No method of confirmation of the income, education, occupation was done apart from the clinical interview. Not many studies are available for socio-economic status in ADHD and neurological soft signs. Micheri et al did a study comparing the children from various regions like Asia, Africa and America and compared the Neurological Soft Signs between each socio-economic group. The Caucasians, Africans and American children were found to have Neurological Soft signs that is independent of their socio-economic status

In our study, correlations were drawn for socio-economic status and other variables like overflow, gaits and stations, total timed, total

PANESS and MPA Scale. No significant positive correlations were noted. The reason probably is due to unequal number of children in various classes in both the groups and a decreased sample size. So even if the correlations were established, it couldn't be given much importance.

Gender Influences

Although ADHD affect both genders most of the research literature including Studies evaluating neurophysiological functioning is devoted to males. Garb and Carlson's review indicated that few studies which included sufficient number of females warrants gender based conclusions. There are data suggesting a high impact of ADHD in girls similar to boys. In one of the study conducted using Diagnostic and Statistical Manual of mental disorders 3rd edition ADHD has same patterns of co morbidity as that of boys

Recent work by authors reporting on a larger data on girls with ADHD identified more similarities than differences when important features of ADHD are considered. Girls were more likely than boys to have a higher rate of predominantly inattentive type of ADHD, a lesser likelihood to have a learning disorder, a lesser likelihood to have a Neurological soft Sign and a lower risk to have a co-morbid conduct disorder and oppositional defiant disorder.

Some research suggests that girls with ADHD are more neurophysiologically impaired than boys with ADHD. This observation while receiving some support for measures of intelligence may not generalize to executive functions which only partially overlap with intelligence. Many studies show no significant difference between girls and boys with ADHD on executive function. Hughton et a. found differences between girls with ADHD and controls on the stroop and WCST, but they failed to find difference between girls and boys with ADHD. Castlellanos et al demonstrated that girls with ADHD performed more poorly than healthy controls on delayed response and go-no-go occulomotor task consistent with executive functional impairments than that have been noted in boys

Only 2 studies so far have been found with significant gender differences between boys and girls with attention deficit hyperactive disorder on motor tasks. Rucklidge and Tannock found that both girls and boys with ADHD (aged 13-16) were impaired in processing speed compared with normal teenagers. But the boys with ADHD were slower in processing speed than girls with ADHD. Newcorn et al found that girls with ADHD made significantly lower errors in timed motor tasks than the boys with ADHD although no normal controls were studied.

Our literature review suggests there is motor function impairment in girls with ADHD but it provides limited data about gender differences. Moreover methodological limitations impede conclusive interpretations. These include

1. Small sample sizes that do not provide enough power to be conclusive
2. Failure to routinely include a substantial and equal group of male and female controls to address a normal sex difference
3. Relatively limited sets of executive functions measures that may not enable an evaluation of an appropriate range of measurements

These data suggested that well controlled study using a larger sample of boys and girls with ADHD is essential to help us in studying gender differences. Few authors from North America performed such a study whether girls with ADHD have soft sign impairment compared with healthy controls. Information on neurological soft signs was obtained in standardized manner blind to clinical status, primary analysis controlled for age, socio-economic status, learning disability and co-morbidity. Girls with ADHD were significantly more impaired on motor functions than comparison girls. The relative to healthy comparisons, girls with ADHD were significantly more impaired on overflow and mirror movements.

In our study, independent t-Test were separately applied to both case and Control group comparing girls and boys for overflow, gaits and stations, total timed, total PANESS and MPA scale showed no significant differences. Although many studies suggest a decreased motor functions in girls compared with boys with ADHD, no specific studies were available for ADHD siblings and controls. The total number of boys and girls in our study were not similar and matched between the two groups. So the insignificant results comparing the Neurological Soft signs and Minor physical Anomalies between the two groups shouldn't be taken into account. To clearly delineate the differences if at all present, we need a large sample that is adequately matched between the two groups.

ADHD and neurological soft signs

V.C. Patankar et al of Topiwala medical college, Mumbai studied the Correlation of Neurological Soft Signs with ADHD and correlation between severity of ADHD and specific motor signs. His study showed 84% correlation of ADHD children with Neurological Soft Signs and NSS are independent of specific learning disorder. Dysrhythmia and overflow are positively correlated with impulsive and hyper active type. Fellick et. al. studied six Neurological Soft Signs and he found that, there is about 25% sensitivity of Neurological soft Signs in detecting ADHD.

Augusto Passini et al studied the role of dopamine in neural network as the Core concept for Neurological Soft Signs in ADHD. Daniel P Dickenstain et al had studied soft signs in ADHD where he concluded that decreased timed movements in ADHD children were probably due to Fronto-Striato-basal ganglia neuro circuit responsible for this.

Anne et al of Europe studied Neurological Soft Signs in ADHD and bipolar disorder. The results of the study showed that ADHD children show more soft signs compared with bipolar disorder. 89% of soft signs were evident in children with ADHD. She used NUBU and the positive predictive value for NUBU and diagnostic of NUBU- is 80%. Ferrin et al studied the Neurological Soft Sign as a diagnostic tool for ADHD and drew a relative receiver operator curve. The receiver operator curve showed a score of 13 according to SDNE scale.

Martin et. al. followed 150 children and found that Neurological Soft Signs decreases with time and rate differs with male and female. Shafer et. al. compared the index case soft sign positive children and control soft sign free children followed up for 17 years. Index cases showed more behavioural problems and psychiatric disturbances compared with soft sign free children. Shatmari studied the overflow variable in ADHD. He found that overflow is more associated with

behavioural problems. Piek et al showed that ADHD is associated with increased in coordination impulsive type showing poorer fine motor skill and combined type showing gross motor skill. Martha Denckla separately studied the motor development in ADHD and scores for speed, rhythm and overflow were classified. She found that 89% of ADHD showed a defective motor development with various different percentages for speed, rhythm and overflow.

Although not much studies are available between the neurological soft signs and ADHD siblings we did this study keeping in mind the genetic influence of ADHD to be common with Neurological Soft Signs and Minor Physical Anomalies. Independent t-Tests were applied between the ADHD siblings and normal controls comparing the neurological soft signs and minor physical anomalies between the two groups and the overflow, gaits and stations, total timed and total PANESS showed a significant difference with a p-Value < 0.05 between the two groups whereas the significant difference were not evident in MPA scale between the two groups. This study could be first of its kind to study the Neurological Soft Signs in ADHD children when comparing with the normal controls. The previous study by V. C. Patankar et. al. in Mumbai was done with 52 children and our study has a sample size of 57.

Genetic Influences

The analysis of motor functions into sub-components and the mapping of Attention functions on to different brain regions support the proposition that response inhibition and executive function in ADHD are associated neuroanatomical and neurophysiological abnormalities in specific region of brain. The research in this area of the children is limited. Casey et al found that performance on 3 neurological sign correlated only with the structural abnormalities of Fronto-Striatal-circuitry observed to be abnormal in ADHD especially in pre frontal cortex, caudate but not the putamen). The correlations between the performance and functioning of pre frontal cortex and caudate nuclei shows predominance in right side of the brain.

Semrud-Clikeman et al also studied children and found a significant relationship between caudate, asymmetry and executive motor signs. Three small signs of adults using functional MRI (positron emission tomography) provided evidence that anterior cingulate and pre-frontal cortex are dysfunctional when performing response inhibition and timed motor task. There is some limited evidence from studies of children with ADHD that motor functions associated with ADHD are correlated with brain volume abnormalities.

In our study, we used ADHD siblings are included in the case group keeping in mind, the siblings have a similar genetic influence and subtle signs similar to ADHD children. So neurological soft signs are studied in ADHD siblings and significant statistical differences were noted. It gives the scope for future research that a common genetic factor or a regional brain abnormality could be responsible for the Neurological Soft Signs.

Minor Physical Anomalies

Waldrop et al studied the Minor Physical Anomalies and results of his study suggest that MPA are more significantly correlated with the ADHD especially cranio-facial anomalies. Fogel et al did a longitudinal study. He followed Minor Physical Anomalies for 14 years and incidence of ADHD was diagnosed from abnormal MPA scale in childhood. He concluded the study by saying MPA is not a diagnostic tool but can be used in prevention and intervention. Firestone et al compared the Minor Physical Anomalies and behaviours between male and females. The results state a significant correlation of MPA with hyperactivity.

Ching and Chang et al of China followed abnormal MPA children in childhood for 10 years and administered BSRS in adults and he tried to arrive the risk factors for anxiety, depression and future mental problems. The results showed a significant behavioural problem in adult with MPA

in childhood. Lee et al Studied the MPA as a tool for diagnosis for psychosis but similar studies was not available for ADHD.

Abaheline et al studied the Minor Physical Anomalies by Waldrop and correlation is poor in schizophrenic children although positive correlation is showed for ADHD children, sex related differences were also studied. Holden et al studied the reliability of PANESS and also the correlation between the minor physical anomalies and ADHD. The results showed a significant correlation.

In our study, minor physical anomalies are evaluated by Waldrop physical anomaly scale and studied for both case and control group. The study shows no significant statistical difference between the two groups though neurological soft signs showed a significant statistical difference. The correlation between Minor Physical anomalies and different variables of neurological soft signs were separately studied. In case group there is a positive correlation of MPA scale with overflow items, total timed and total PANESS. Whereas in control group no such correlations were noted and there is a positive correlation for Total PANESS with minor physical anomalies.

Although there are not much studies for individual domains of Neurological Soft Signs comparing with Minor Physical Anomalies, our study will be the first of its kind to study the correlation between the

minor physical anomalies and various domains of Neurological Soft Signs if at all any. The positive correlation in overflow, total timed, total PANESS among ADHD siblings with MPA scale gives a positive outlook for further future studies on Minor Physical Anomalies.

SUMMARY

The design of the study is case control study. Siblings of ADHD children are considered as case and normal children as controls. 57 children are included in each group. The total number of children included in the study comes to 114. The total number of males were 74(64.9%) and females 40(35.1%). The socio-economic class for the children in both the case and control group were recorded.

On comparing the overflow, gaits and stations, total timed, total PANESS, MPA scale between the two groups, by independent t-Test. Siblings of ADHD showed a significant difference in overflow, gaits and stations, total timed, total PANESS when compared with age matched controls. There is no significant difference in minor physical anomalies.

In comparing the soft sign variables and MPA in both the case and control group separately for males and females there appears no significant difference between the two groups. There is a correlation of overflow, total timed and total PANESS with minor physical anomalies in case group. And there is a correlation for total PANESS with minor physical anomalies in control group. There is no correlation noted between the domains of soft sign and minor physical anomalies for a particular socio-economic class in both case and control group except for positive correlation seen between soft sign domains and Minor Physical Anomalies in lower middle and upper lower group for ADHD siblings.

CONCLUSION

1. ADHD siblings showed a significant difference in Neurological Soft Signs when compared with the normal children.
2. ADHD siblings fail to show a significant difference in Minor Physical Anomalies when compared with normal children.
3. The inter correlation of Minor Physical Anomalies with various domains of Neurological Soft Signs showed a positivity for overflow and timed for ADHD siblings.
4. There is no inter correlation of Minor Physical Anomalies with Neurological Soft Signs for normal children.
5. There is no significant difference between males and females for both the ADHD siblings and normal children in Neurological Soft Signs and Minor Physical Siblings.
6. For ADHD siblings overflow movements and timed movements are positively correlated to Minor Physical Anomalies in lower middle class and timed movements are positively correlated to minor physical Anomalies in upper lower groups.

FUTURE RECOMMENDATIONS

1. There are many studies that have been conducted in Neurological Soft Signs in ADHD children. There are many questions that are still unanswered. First, our knowledge about neurophysiological information on ADHD is very little especially for adult where our knowledge is meagre.
2. Most of the studies that were done previously were cross sectional studies. Many follow up studies need to be done to study age dependent changes in soft signs and minor physical anomalies.
3. Combining both the Neurological Soft sign with the structural and functional imaging in near future helps us in having a healthier understanding of the disorder.
4. There is a need for many studies to study the link between genetic components of ADHD with measures of brain dysfunction, as we are still at the backyard of developing a imaging modality for genes corresponding to ADHD, we believe that when the susceptibility is confirmed for the genes, imaging resources that could be developed in near future can test gene brain associations.
5. Additional issues in evaluating the significance of Neurological Soft Signs in ADHD is whether the soft signs are specific to this disorder in view of broad neuro circuitry involvement

6. It is said that the ADHD symptoms overlap with certain disorders of the adult some symptoms have been shown to be specific in childhood comparisons with other neurodevelopmental disorders; it has been shown that the overall profile of neurophysiological functioning is different from other disorders.
7. There is a need to study the various domains of neurological soft signs in detail and their association with ADHD in near future although there are significant studies for ADHD and Neurological Soft Signs, genetic predisposition to develop imaging resources with a lot more studies with ADHD siblings should come in the near future.
8. Also more number of studies are warranted for Minor Physical Anomalies in ADHD siblings as early diagnosis of ADHD could be a possibility in children born with minor physical anomalies even before 3 years.

LIMITATIONS

1. Decreased sample size for both case and control groups. Further increase in samples could provide us with more reliable statistics.
2. The PANESS neurological soft sign scale and Waldrop minor physical anomalies scale uses standards for foreign children. The standardization for Indian children is warranted.
3. Separate studies need to be conducted for correlation for neurological soft signs, minor physical anomalies, gender, age and socio economic class. The reliability of the study reduces considerably when we try to study to much variables in a single study.
4. There is no follow up of neurological evaluation and Minor Physical Anomalies done during the study. Longitudinal studies would help further in studying the Neurological Soft Signs and Minor Physical Anomalies in detail.
5. Behavioural disorders and severity of ADHD are not considered in this study.
6. Correlation between IQ of the child with Neurological Soft Signs and Minor Physical Anomalies warrants high reliability of the study.

ANNEXURE

DATA COLLECTION FORM

FOR NORMAL CONTROLS

NAME :

AGE/SEX :

ACADEMIC STATUS :

FATHER'S NAME :

MOTHER'S NAME :

ADDRESS :

SOCIOECONOMIC STATUS :

ANY CLINICAL SYMPTOM :

ANY SIGNIFICANT MEDICAL ILLNESS IN THE PAST :

FAMILY HISTORY OF PSYCHIATRIC ILLNESS :

VITALS :

ANTHROPOMETRY :

GENERAL EXAMINATION :

SYSTEMS EXAMINATION :

POINTS POSITIVE IN DSM V CRITERIA IN ADHD :

SCORE FOR NSS BY PANESS :

SCORE FOR MPA BY WALDROP :

DATA COLLECTION FORM

FOR THE ADHD CHILD

NAME :

AGE :

SEX :

ACADEMIC STATUS :

SYMPTOMS OF ADHD PRESENT :

SIGNIFICANT PAST HISTORY :

SIGNIFICANT EXAMINATION FINDINGS :

NO OF POINTS POSITIVE IN DSM V CRITERIA :

FATHER'S NAME :

FATHER'S OCCUPATION :

MOTHER'S NAME :

MOTHER'S OCCUPATION :

NO OF SIBLINGS TO THE CHILD :

SOCIOECONOMIC CLASS (MODIFIED KUPPUSAMY SCALE):

ADDRESS :

FOR THE SIBLING CHILD

NAME :

AGE/SEX :

ACADEMIC STATUS :

COMPLAINTS IF ANY :

HISTORY OF ANY MEDICAL :

ILLNESS/TREATMENT IN THE PAST :

VITALS :

ANTTHROPOMETRY :

GENERAL EXAMINATION :

NEUROLOGICAL EXAMINATION :

POINTS POSITIVE IN DSM V CRITERIA FOR ADHD:

SCORE FOR NSS BY PANESS :

SCORE FOR MPA BY WALDROP :

ஆராய்ச்சி ஒப்புதல் கடிதம்

ஆராய்ச்சி தலைப்பு

கவனக்குறைவும், அதிக துறுத்துறுப்புத் தன்மையும் கொண்ட ADHD என்று சொல்லப்படும் மனக்குறைபாடு உள்ள குழந்தைகளின் சகோதர, சகோதரிகளுக்கும் மற்ற குழந்தைகளுக்கும் நரம்பியல் சார்ந்த நுண்ணறிகுறிகளையும், (Neurological Soft Signs) நுட்பமான அங்க குறைபாடுகளையும் (Minor Physical Anomalies) ஒப்பிடும் ஆராய்ச்சி.

பெயர் : தேதி :

வயது : வெளி நோயாளி எண் :

பால் : மனநல பகுதி எண். :

இந்த ஆராய்ச்சியின் விவரங்களும் அதன் நோக்கங்களும் முழுமையாக எனக்கு விளக்கப்பட்டது.

என் குழந்தைக்கு ADHD என்று சொல்லப்படும் மனக்குறைபாடுக்கான பரிசோதனையும் நரம்பியல் சார்ந்த நுண்ணறிகுறிகளையும், (Neurological Soft Signs) நுட்பமான அங்க குறைபாடுகளையும் (Minor Physical Anomalies) இந்த ஆராய்ச்சியின் மூலம் கண்டறியப்படும் என்பதை நான் புரிந்து கொண்டு இந்த ஆராய்ச்சிக்கு சம்மதிக்கிறேன்.

வலி ஏற்படும் எந்த ஒரு சோதனையும், ரத்தம் எடுத்து பரிசோதனை செய்யும் முறைகளும் இந்த ஆராய்ச்சியில் இல்லை என்று தெரிந்து கொண்டேன்.

இந்த ஆராய்ச்சியில் பிறரின் நிர்பந்தமின்றி என் சொந்த விருப்பத்தின் பேரில் தான் பங்கு பெறுகிறேன்.

இந்த ஆராய்ச்சியில் இருந்து எந்நேரமும் காரணம் தெரிவிக்காமல் பின்வாங்கலாம் என்பதையும், அதனால் என் குழந்தையின் சிகிச்சைக்கு எந்த பாதிப்பும் ஏற்படாது என்பதை தெரிந்து கொண்டேன்.

என்னுடைய குழந்தையின் நோய் தகவல்களையும் மற்ற உடல்நிலை சார்ந்த தகவல்களை மற்ற மருத்துவர்களுக்கோ, ஆராய்ச்சி சார்ந்த அதிகாரிகளுக்கோ தேவை ஏற்பட்டால் தெரிவிக்க சம்மதிக்கிறேன். நான் என்னுடைய சுயநினைவுடனும், முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சியில் சேர்ந்து கொள்ள சம்மதிக்கிறேன்.

ஆராய்ச்சியாளரின் கையொப்பம் தாய் / தந்தை கையொப்பம்

தேதி

INFORMED CONSENT FORM

Study place: INSTITUTE OF CHILD HEALTH AND HOSPITAL FOR CHILDREN, child guidance clinic &medical wards.

Title of the study: **A STUDY ON NEUROLOGICAL SOFT SIGNS AND MINOR PHYSICAL ANOMALIES IN SIBLINGS OF ADHD CHILDRENIN COMPARISON WITH NORMAL CONTROLS**

Name of the Investigator : **Dr.JAYENDRA . S.**

Name of the Participant: Age: Sex:

Hospital number: CGC no:

1. I have read and understood this consent form and the information provided to me regarding the participation in the study.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study.
4. I have been explained about my rights and responsibilities by the investigator.
5. I will allow my child to undergo clinical tests subjected during the study whole heartedly.
6. I will allow my child to cooperate with the investigator through out the Study
7. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital. *
8. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, only with my consent. *
9. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.
10. I have understand that my identity will be kept confidential if my data are publicly presented
11. I have had my questions answered to my satisfaction.

12. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me. I will be given a copy of this consent document.

Name and signature / thumb impression of the parents/guardian

Name _____ Signature_____ Date_____

Name and Signature of impartial witness:

Name _____ Signature_____ Date_____

Name and Signature of the investigator or his representative obtaining consent:

Name _____ Signature_____ Date_____

PANESS ARTICLE

Rapport should be established by a few minutes of conversation. Acclimatization to test circumstances may then be phased in by one or two simple unscored tasks, such as, can u show me your right foot, good, now point to your left ear. Above all, a completely encouraging non punitive atmosphere is required. Right or left handedness should be recorded before the test begins.

Lateral Preferences

1. Eye

"I want you to take this piece of paper in both hands and look at me through the hole in the paper. Good. Now look at me with the other eye." (Hand the person a piece of paper no smaller than 8 by 5 inches, or half of an8 1/2x 11 inches standard sheet in which a hole is punched centrally) (shift of eye to other helps confirm first choice observation).

2. Foot and Hand

"I want to see which side you like to use to do things, so I m going to ask you to make believe a lot of actions. Try to do each action without thinking about which side is better-try to be natural. O.K.? Now show me how you kick a ball, stamp out a burning cigarette.

3. Show me how you comb your hair, brush your teeth, cut with scissors, throw a ball.

Scoring : Lateral Preference Pattern

1 - All items Right

2 - All items left

3 - Some right, some Left (Mixed)

4 - Eye alone is different from other items

4. Walking on Heels

"Walk this line to the end up on your heels, like this". The examiner should wait at the line. This serves two purposes first he remains close to the child to protect against falling, and secondly, he will be positioned for the next demonstration, the return trip. Score: for this and for the next walking items, which are stressed gaits. Score: for feet-to-hanks overflow posture which side, or other abnormal specific posture.

5.Walking on toes

"Now go back on your toes, like this," (Arms by side , walk on balls of feet on the line, If person tries to get up on toes like ballet `en pointe` demonstrate moderate position for toe-walk and explain) Score: The same method as in heel-walk is used.

6. Walking on outsides of Feet (Everted Gait)

"Now walk like this" (Arms at side, examiner walk on outer border of feet, showing eversion position).

Score: as for heel-walking and toe-walking.

7. Tandem Walking Forward

"Now be sure you put your heel against your toe and walk to the end staying on the line" (Demonstrate heel-toe walking on line and remain at the end).

Score: An error consists of not placing the heel to toe or missing the line completely. Code number of gaps, misses, failure to place heel to toe.

8. Tandem Walking Backward

"Now do the same thing backwards". Score as in test for forward tandem gait.

9. Sustentation/Steadiness Item

"Now put your feet next to each other, close side-by-side, raise your arms level with shoulders like this, spread all your fingers apart, close your eyes , stay as still as you can like this for as long as you can or until I say relax" (Demonstrate stance, arms up and straight out at shoulder level, fingers abducted, eyes closed. Time with stopwatch duration of success up to 20sec. Watch for involuntary movements)

Score: Code as in item above plus code involuntary movements

10.Sustentation/steadiness Item

Now put your feet next to each other, close side-by side, raise your arms level with shoulders like this, spread all your fingers apart, close your eyes, stay as still as you can like this for as long as you can or until I say relax`

(Demonstrate stance, arms up and straight out at shoulder level, fingers abducted, eyes closed. Time with stopwatch duration of success up to 20sec.Watch for involuntary movements).

Score: Code as in item above plus code involuntary movements.

11. Finger-to-nose

"Now, before you open your eyes, touch the tip of your nose with one pointer finger. Good, now with the other pointer finger." (If not done correctly without demonstration, i.e., directly following upon the 2- seconds in the sustained position, then allow examinee to open eyes and watch demonstration of index-finger-to-nose.)

Score : 0 - No problem

1 - Misses nose or wobbles en route

12.Tongue Protrusion Item

"Now, relax a minute. Keep your arms relaxed, stand in a comfortable way, but close your eyes again and gently stuck out your

tongue and deep your tongue as still and steady as you can for a few more seconds."

(Demonstrate relaxed but eyes-closed stance. tongue gently protruded and keep steady. Observe sustaining and or involuntary darting tongue movements.

Score: Code sustaining, as above; involuntary movements (1) as above.

13. Eyes closed Item

"Close your eyes tightly and keep them closed that way as long as you can or till I say relax". Score: Code duration of uninterrupted sustained success.

Balancing Item "Now I want you to stand on one leg for as long as you can, up to one-half of one minute. Then I will say relax". (Demonstrate balance by standing on one leg with arms relaxed at side and one leg lifted off floor, bent back at knee. Correct any exaggerated or `ballet` postures of raised leg attempted by examinee and re-demonstrate. Allow choice of first leg to stand balanced upon, and by examinee and record choice).

Score : Record first leg and its balance time (see groupings on form; up to 30 sec). Record for other leg similarly, designate as second performance.

14. Hopping

"Next, I want you to hop up and down over and over again in the same spot, not moving across the room, but more like a `Jack-in-the-box. `Don't worry about an exact spot, just keep hopping up and down without travelling. Choose whatever foot you like to hop first; then we`ll do the other. Keep hopping till I stop counting! Ready?". "Now `repeat for second for second foot `Now do the same hopping on the other foot `Ready? Now! (Show hopping in place and gently correct if hopping is of progressive moving type)

Timed Coordination Section

These tests require the use of a stopwatch and accurate timing of the performance. It is necessary that the person examined know clearly when the test starts, and that he is told to keep doing the task until the examiner tells him to stop .For each of these tests the child is told, `Now I am going to tell you some things to do; be sure that you don't start dong each one of them until I say begin, Do you understand? Also be sure you continue doing them until I tell you to stop.

Procedures

The principle for all tasks included in the timed coordination battery is that of counting 20 movements. `Time to do twenty` is derived by the examiner by putting on his/her stopwatch after the patient has begun the required movement. The method (as opposed to`----------per 10 seconds`) allows, indeed necessitates, the examiner s close observation of the patient in order to join in and then count and finally stop. The difficult part of the examination is to note performance quality and the simultaneous occurrence of associated (overflow) movements elsewhere than where the examiner is zealously counting.(The recording form, needing only marking0 or 1 for overflow, while time in seconds must be written as read form stopwatch and the letter `d` written next to qualitatively poorly performed items of coordination ,greatly facilitates this part of the evaluation .Overload and loss of information on the examiner`s part may occur without such a form.)

Procedure for counting Overflow

During the process of counting twenty for each movement, the examiner notes and records all movements of other body parts. Generally these movements are `mirrored` in other limbs and the head and occur at the same time as in the part intended to perform the movement.

Thus, for example, while performing heel-toe with the left foot, a patient might `mirror` with right foot(code1 under mirror) as well as extend and flex both hands the wrists(code 1 under Proximal) and dart the tongue in and out of his/her mouth(code 1 under orofacial). For such a performance one would have coded next to the numerical time score independent of speed or quality, a total overflow count of `3` for that single item. At the other extreme, jaw movement associated with tongue –wiggling (code 1 under Proximal ;) would rate `1` overflow point.

Score : Total and asymmetrical overflow points should be tallied at the end of the developmental motor examination. See scoring instructions for derived overflow scores recommended.

General Instructions for Timed Items

"Now we are going to see how fast you can move your feet, hands, fingers and tongue- all your fat muscles. Each time we do a movement, you can choose which side to do first. Also, watch me and I`ll show you each movement."

(Demonstrate each item. Keep shoes on unless either examiner or examinee has on `high heels` in which case remove shoes. Be sure the chairs height allows feet to be flat on the floor).

15. “First, choose one foot and tap it like this, like you are impatiently waiting for someone, on the floor. Keep the heel of your foot on the floor and tap the front of the foot fast, like this. Ready?”. “ Now! the same with other foot”

16. “now , rock one foot back and forth, heel toe heel toe as fast as you can like this.ready? now”

(Repeat for second side for each case)

17.”now we are up to the hands choose one hand and pat it on the lap like this as fast as you can”. Ready? Now!”

(Demonstrate rapid patting, correct, if slaps hard , to gentle fast pats)

18.”The next thing we do with the hands is patting , like this , back and palm, flip-flop, flip flop as fast as you can choose one hand. Ready?.Now!”

(Demonstrate hand pronation and supination alternating pats on laps)

19. “We are now up to the fingers .i want you to tap the thumb and index finger together as fast as you can. Ready?Now”

(Demonstrate thumb index finger rapid tapping)

20.”Now, this is the hardest one we do. Watch me. Tap each finger against the thumb in order, then do them again like this. Don’t go

backwards always this way-index, middle, ring, little. Now try it on other hand.try it as fast as you can. Ready? Now”

(Say finger names and then say 1,2,3,4 as instructed)

21. Tongue wiggles item

“Now we need to do tongue- wiggling. Move tour tongue side to- side, like this, touching each corner of your lips, then the other, back and forth as fast as you can. Ready?.Now”

(Demonstrate tongue going laterally, from one angle of lips to other. correct if does in/out or rotatory movements and re-demonstrate)

Score : For all timed coordination items, numbers are written in form for time in seconds to do 20 movements. First chosen side is underlined or circled on the form.

Here we have given the basic items of PANESS and how to carry upon the scale.

PANESS CODING INSTRUCTIONS Page 1 of 4 Revised 09/19/2003

Demographics: Fill in information at the top of PANESS Coding Sheet. (Name/Subject #, Gender, DOE, DOB, and Age

Lateral Preference: Enter Right (R), Left (L) or Mixed for Eye, Hand, and Foot Preference. Code as Mixed if nondominant hand is preferred for 3 or more items.

When coding PANESS scores, note that some activities are coded differently depending upon age:

Asterisks indicate where an **Age Appropriate PANESS Score** is coded**.** When an Age Appropriate PANESS Score is specified, only sum the scores that are abnormal for age group. Do not include the score in the total if the score is normal for the child's age group.

If "CD" (Child tried but failed or couldn't do) is circled on the PANESS, code the score as a "2" **only if** movement is expected to be WNL for age group.

GAITS & STATIONS (for PANESS Coding Sheet – Page 1)

 Circle 0, 1 or 2 for right and left Gaits (#'s 1, 2, and 3) and for unilateral Tandems (# 4 and 5).

i. For Sides (#3), Code errors only if child is equal to or greater than **9** years old; if child is less than or equal to 8 years of age, code as 0 regardless of error

ii. For Backward Tandem (#5), Code errors only if child is equal to or greater than **10** years old; if child is less than or equal to **9** years of age, code as 0 regardless of error

 Circle 0, 1 or 2 for Tandem (#6), Stand with Feet close (#7), Stand on one Foot (#10), and Hopping (#11).

i. Tandem and Stand have unilateral scores only.

ii. Stand on one Foot (#10) and Hopping (#11) have bilateral scores

iii. For Hopping (#11),

a. If child is less than or equal to **8** years old, 25 hops are required for a Score of 0. If child completes 12 to 24 hops, Score as 1. If child completes less than 12 hops, Score as 2.

b. If child is equal to or greater than **9** years old, 50 hops are required for a Score of 0. If child completes 25 to 49 hops, Score as 1. If child completes less than 25 hops, Score as 2.

When adding **Right**, **Left**, and **Total Axial** indices, **Only sum up scores that are <u>not</u> WNL for a child's age – Do not score if errors are OK for the child's age group:**

i. Do not add in score for Sides (#3) if the child is **<u>9</u>** years old or younger.

ii. Do not add in score for Backward Tandem (#5) and Stationary Tandem (#6) if the child is **<u>10</u>** years old or younger.

Right Axial is the total of the numbers circled on the right side for Gaits and Stations (#'s 1-3, 10, 11) with a range of points from 0-10.

Left Axial is the total of the numbers circled on the left side for Gaits and Stations (#'s 1-3, 10, 11) with a range of points from 0-10.

Total Axial is the total of all right and left Axial items and the middle #'s 4,5, 6, and 7 (i.e., items # 1-7 plus 10 and 11.) with a range of points from 0-28.

OVERFLOW GAITS (for PANESS Coding Sheet – Page 1)

For Heels, Toes, and Sides (# 1, 2, and 3), look at **Hand Overflow/postures present?** on the administration form: Circle 0 if no overflow occured. Circle 1 if left or right overflow is present. If B is circled, circle 1 for BOTH right and left overflow.

i. For Heels and Toes (# 1 and 2), Code errors only if child is equal to or greater than **6** years old; if child is less than or equal to 5 years of age, code as 0 regardless of error.

ii. For Sides (#3), Code errors only if child is equal to or greater than **9** years old; if child is less than or equal to 8 years of age, code as 0 regardless of error.

When adding **Right**, **Left**, and **Total Overflow** indices, **Only sum up scores that are not WNL for a child's age – Do not include score if errors are OK for the child's age group:**

I. Do not add in score for Heels (#1) and Toes (#2) if the child is **5** years old or younger.

II. Do not add in score for Sides (#3) if the child is **8** years old or younger.

Right Overflow = Sum of items #1, 2, and 3 on right side with a range of 0-3

Left Overflow = Sum of items #1, 2, and 3 on left side with a range of 0-3

Total Overflow = Sum of ALL items (Right and Left Overflow).

MISC. OBSERVATIONS & INVOLUNTARY MOVEMENTS (for PANESS Coding Sheet – Page 1)

For all Involuntary and Miscellaneous movements, be sure to check the Observation line to see if anything is written that may not have been scored.

For Miscellaneous Observations: Check for observations and comments on all pages (specifically, look at the observation box at bottom of the laterality (first) page and the Observation area after each time).

o Code 0 for **No** and 1 for **Yes** for **hemiparetic posture, dystonic posture, nystagmus, and strabismus.**

o If something is written that is not listed on the coding sheet, code it as **Other** and write in the observation.

o Always code observations according to whether it occurred on the Right and/or Left Side.

o Add up **Right Misc** and **Left Misc** scores for each side. Each has a range of 0-7.

- **For Involuntary Movements:**

o # 7 (Stand with Feed close): Look at the Choreiform item, and circle 1 if choreiform is present or 0 if choreiform is not present for the right and/or left side.

o #8 (Finger to Nose): code 0 if **no tremor** is present, code 1 if **clumsy, mild dysmetria** or **minor limb tremor** are observed, and code 2 if **intention tremor** or **past pointing** are observed on the right and/or left side.

o #9 (STICK out tongue…): Look at the Choreiform (reptile tongue, writhing and darting movements) item, and circle 1 if choreiform is present or 0 if choreiform is not present.

- **For Misc. & Invol Totals:**

o **Right** = Sum of Right Misc. + R Involuntary #7 + Right Involuntary #8 (Range = 0-7).

o **Left** = Sum of Left Misc. + Left Involuntary #7 + Left Involuntary #8 (Range = 0-7).

o **Total** = Sum of Right Misc. & Involuntary + Left Misc. & Involuntary + #9 (Range = 0-15).

OVERFLOW – TIMED MOVEMENTS (for PANESS Coding Sheet – Page 2)

Timed Overflow movements are found on the last page (timed motor movements) of PANESS Form.

- Look at the 3 boxes to the right of the times for each movement: **Proximal**, **Orofacial** and **Mirror Overflow.** For each movement, circle either a 0, 1, or 2 for the right and left sides.

o If only Proximal or only Orofacial or only Mirror is circled, then Circle 1

o If Proximal AND Orofacial are circled, then Circle 1

o If Proximal AND Mirror are circled, then Circle 2

o If Orofacial AND Mirror are circled, then Circle 2

o If Proximal, Orofacial and Mirror are all circled, then Circle 2

- In the shaded areas under **PANESS Score**, transfer the scores over to the blanks. When there is an asterisk (*) by a blank, only transfer the score over if the overflow is NOT age appropriate for that child. If overflow is WNL for the child's age group, change the score to a 0. For example, if mirror movement is OK until 9 year old, and the child is only 8 years old and has mirror overflow present, do not transfer over the error – instead, change the score to a 0.

- Circle 1 for **Yes** and 0 for **No** if the child displays jaw synkinesis for the **Tongue** movement.

- Add up the numbers on the blanks in the shaded area (not the circled numbers) for both the Right side and the Left side to derive the totals for **Timed Right Overflow** (Range = 0-12) and **Timed Left Overflow** (Range = 0-12).

- **Total Timed Overflow** = Timed Right Overflow +Timed Left Overflow + Tongue (Range = 0-25).

DYSRHYTHMIA – TIMED MOVEMENTS (for PANESS Coding Sheet – Page 2)

Look at the last column (**DYS-RHYTHMIC/SEQUENCING ERROR**) on the timed motor movements page.

For each timed movement, circle 0 (not present) or 1 (present) for Right and/or Left sides.

Add up **Right Dysrhythmia** (Range = 0-6) and **Left Dysrhythmia** (Range = 0-6) scores for each side.

Circle 0 (present) or 1 (not present) for dysrhythmia in the **tongue** movement.

Total Dysrhythmia = Right Dysrhythmia + Left Dysrhythmia + Tongue (Range = 0-13).

MISC. TIMED OBSERVATIONS (for PANESS Coding Sheet – Page 2)

Check to see if there are any notes written on the timed motor movements page that are not already coded under Overflow or Dysrhythmia.

If nothing is noted, circle all zeros.

If an observation is noted, code as a 1 for **Choreoathetoid**, **Hemiparetic**, or **Other**.

Add up **Right Timed Misc.** (Range = 0-3) and **Left Timed Misc.** (Range = 0-3) scores for each side.

Total Timed Misc. = **Right Timed Misc.** + **Left Timed Misc.** (Range = 0 – 6).

TIMED MOVEMENTS: (SFA Scores) (for PANESS Coding Sheet – Page 3)

- Under **seconds,** write in the times for each movement to decimal points for each Right and Left sided movement. Make sure to put the times for the Right side in the R column and times for the Left side in the L column.

- Under **z-score**, calculate z-values using the child's normative Mean and Standard Deviation from the PANESS Timed Motor Movements Norms.

o Be sure to use the correct norms for the child's **age**, **gender**, and **handedness**.

o Use right-handed norms for left-handed children **11** years or older.

o Calculate **reverse scored z-values** [(Normative score - Child's Score) / Standard Deviation (SD)] so that positive scores indicate better performance and negative scores indicate worse performance.

- To determine the **SFA score**:

o If z-score is greater than -1 SD below the mean (i.e., Child is WNL or Child is more than 1 SD above the mean, thus faster), SFA = 0

o If z-score is between -1 SD and -2 SD below the mean, SFA = 1

o If z-score is less than -2 SD below the mean (i.e., indicating very poor performance), SFA = 2

- Add up **Right SFA** (Range = 0-12) and **Left SFA** (Range = 0-12) scores for each side.

- Circle either 0 or 2 for the tongue.

o If the child is age **5-9**, the mean is < 6 seconds. If Time is ≤ 6 seconds, score as 0. If time > 6 seconds, score as 2.

o If the child is age **10 or above**, the mean is < 3 seconds. If Time is ≤ 3 seconds, score as 0. If time > 3 seconds, score as 2.

- **Total SFA** = **Right SFA** + **Left SFA** + **Tongue** (Range = 0 – 26).

TOTALS (for PANESS Coding Sheet – Page 3)

When adding up the totals, formulas for calculations are in parentheses with the page number in brackets referring to where the subtotal was already calculated on a previous page. Asterisks (*) indicate totals in which only abnormal scores for age group should be included in total.

Total Right Overflow = (*Right Overflow [from page 1] + *Timed Right Overflow [from page 2])

(Range 0-15)

Total Left Overflow = (*Left Overflow [from page 1] + *Timed Left Overflow [from page 2])

(Range 0-15)

Total Overflow = (*Total Overflow [from page 1] + *Timed Total Overflow [from page 2])

(Range 0-31)

Total Gaits & Stations = (Total Axial [from page 1] + *Total Overflow [from page 1] + Total Miscellaneous & Involuntary [from page 1])

(Range 0-49)

Total Timed = (Total Timed Overflow [from page 2] + Total Dysrhythmia [from page 2] + Total Timed Misc. [from page 2] + Total SFA [from page 3])

(Range 0-70)

Total PANESS = (Total Gaits and Stations + Total Timed)

(Range 0-119)

PANESS CODING SHEET

Name/Subject #: DOE: Age:

Gender: DoB:

Lateral Preference: EYE: R L FOOT: R L HAND: R L

Mixed :

Code PANESS scores below. Note that some movements are coded differently depending upon age.

If "CD" is circled on the PANESS, code as a "2" if movement is expected to be WNL for age group.

Tandems, Stand, and Tongue have unilateral scores only.

GAITS	**R**	**L**
1. Heels	0 1 2	0 1 2
2. Toes	0 1 2	0 1 2
3. Sides	0 1 2	0 1 2

(Code errors only if age ≥9 yo; if age ≤ 8, code as 0 regardless of errors)

1. Forward Tandem	0 1 2
2. Backward Tandem	0 1 2

(Code errors only if age ≥10 yo; if age ≤ 9, code as 0 regardless of errors)

STATIONS <u>R L</u>

1. Tandem 0 1 2

(Code errors only if age ≥10 yo)

1. Stand with Two Feet 0 1 2

Right Axial = _____ (R side #1-3, 10, 11)

(Range 0-10)

1. Stand on one foot 0 1 2 0 1 2

Left Axial = _____ (L side #1-3, 10, 11)

(Range 0-10)

1. Hop (Unilateral) 0 1 2 0 1 2

Total Axial = _____ (R + L + 4,5, 6, 7)

(Range 0-28)

OVERFLOW GAITS	**R**	**L**	
1. Heels	0 1	01	*__Right Overflow__ = ___
(Code errors only if age ≥6 yo)			(Range 0-3)
1. Toes	0 1	01	*__Left Overflow__ = ____
(Code errors only if age ≥6 yo)			(Range 0-3)
1. Sides	0 1	01	*__Total Overflow__ = ____
(Code errors only if age ≥9 yo)			(Range 0-6)

INVOLUNTARY MOVEMENTS

	R	**L**
1. Choreiform	0 1	0 1
(Abnormal arm/finger movements)		
1. Tremor	0 1 2	0 1 2
(Finger to nose)		
1. Choreiform	0 1	
(Reptile tongue)		

MISC. OBSERVATIONS

	R	**L**	
Posture Hemiparetic	0 1	01	**Miscellaneous and Involuntary Totals**
Posture Dystonic	0 1	01	**Right** = _____
(R Invol. 7 + R Invol. 8 + R Misc.)			(Range 0-7)
Nystagmus	0 1	0 1	**Left** = _____
(L Invol. 7 + L Invol. 8 + L Misc.)			(Range 0-7)
Strabismus	0 1	0 1	**Total** = _____

(R Misc. & Invol. + L Misc.& Invol + Invol. 9) (Range 0-15)

Right Misc. _____ **Left Misc. _____**

(Range 0-7) (Range 0-7)

Total Gaits and Stations = _____ (Total Axial + *Total Overflow + Total Miscellaneous & Involuntary)

*Code as Mixed if nondominant hand is preferred for 3 or more items.

***Note**:

Age Appropriate PANESS Score:

Only sum scores here if abnormal for age – Do not include score here if normal for the child's age group.

OVERFLOW – TIMED MOVEMENTS

	R	**L**
Foot Tap (FT)	0 1 2	0 1 2
Heel/toe tap (HT)	0 1 2	0 1 2
Hand Pat (HP)	0 1 2	0 1 2
Hand Pronate/Supinate (HPS)	0 1 2 *	0 1 2 *
(For Mirror, Code errors only if age ≥9 yo)		
Finger Tap (FR)	0 1 2	0 1 2
Finger Apposition (FS)	0 1 2 *	0 1 2 *
(For Mirror, Code errors only if age ≥13 yo)		
	*__Timed Right Overflow__ *	__Timed Left Overflow__
	(Range 0-12)	(Range 0-12)

Under **R** and **L**, transfer scores directly from PANESS. Code as a

Score of 0 if no overflow is present regardless of age appropriateness.

Score of 1 if only Proximal **or** Oro-Facial **or** Mirror are present or if both Proximal **AND** Oro-facial

Score of 2 if Both Proximal **AND** Mirror or if both Oro-facial **AND** Mirror or Proximal **AND** Oro-facial **AND** Mirror

Under **PANESS Score**, directly transfer scores from answers recorded under Right and Left, except when asterisk is present. If *, copy the score to the **PANESS Score** only if score is abnormal for age; otherwise, if age appropriate, change score to 0 in this column.

Tongue (jaw synkinesis) 0 1

***Total Timed Overflow** (Sum R Overflow + L Overflow + Tongue)

(Range 0-25)

DYSRHYTHMIA – TIMED MOVEMENTS

	R	**L**
Foot Tap (FT)	0 1	0 1
Heel/toe tap (HT)	0 1	0 1
Hand Pat (HP)	0 1	0 1
Hand Pronate/Supinate (HPS)	0 1	0 1
Finger Tap (FR)	0 1	0 1
Finger Apposition (FS)	0 1	0 1

Right Dysrhythmia **Left Dysrhythmia**

(Range 0-6) (Range 0-6)

Tongue 0 1

Total Dysrhythmia

(Sum R Dysrhythmia + L Dysrhythmia + Tongue) (Range 0-13)

MISC. TIMED OBSERVATIONS

	R	L
Choreoathetoid	0 1	0 1
(Extended arm/elbow turned outward)		
Hemiparetic	0 1	0 1
(Flexed elbow)		
Other (_____)	0 1	0 1

Right Timed Misc.

(Range 0-3)

Left Timed Misc.

(Range 0-3)

Total Timed Misc.

(Range 0-6)

TIMED MOVEMENTS (SFA Scores)

	Right			**Left**	
	Seconds	**z-Score**	**SFA Score**	**Seconds**	**Z-Score**	**SFA Score**
FT			0 1 2			0 1 2
HT			0 1 2			0 1 2
HP			0 1 2			0 1 2
HPS			0 1 2			0 1 2
FR			0 1 2			0 1 2
FS			0 1 2			0 1 2
	Right SFA			**Left SFA**		
	(Range 0-12)			(Range 0-12)		

Under **Seconds,** copy times in seconds to decimal points for each Right and Left sided movement.

Under **z-Score**, calculate z-values using Mean and Standard Deviation from the PANESS Timed Motor Movements Norms.

Normative data are stratified by child's **age**, **gender**, and **handedness**.

Use right-handed norms for left-handed children 11 years or older.

Calculate reverse scored z-values [(Normative score - Child's Score) / Standard Deviation (SD)] so that positive scores indicate better performance.

To determine **SFA score**:

If **z-score** is greater than -1 SD below the mean (i.e., Child is WNL or Child is more than 1 SD above the mean, thus faster), SFA = 0

If **z-score** is between -1 SD and -2 SD below the mean, SFA = 1

If **z-score** is less than -2 SD below the mean (i.e., indicating very poor performance), SFA = 2

Tongue 0 2

(jaw synkinesis)

Circle 0 or 2 for the tongue. If the child is:

For children age 5-9, the mean is **< 6** seconds: **For children Age 10 and above**, the mean is <3 seconds:

If Time is ≤ 6 seconds, score as 0. If time > 6 seconds, score as 2. If Time is ≤ 3 seconds, score as 0. If time > 3 seconds, score as 2.

***Total SFA** (Sum R SFA + L SFA + Tongue SFA)

(Range 0-26)

TOTALS

Total Right Overflow _____ (*Right Overflow [pg 1] +

(Range 0-15) (Range 0-3)

*Timed Right Overflow [pg 2])

(Range 0-12)

Total Left Overflow _____ (*Left Overflow [pg 1] +

(Range 0-15) (Range 0-3)

*Timed Left Overflow [pg 2])

(Range 0-12)

Total Overflow _____ (*Total Overflow [pg 1] +

(Range 0-31) (Range 0-6)

* Total Timed Overflow [pg 2])

(Range 0-25)

Total Gaits & Stations _____ (Total Axial [pg 1] +

(Range 0-49) (0-28)

*Total Overflow [pg 1] + Total Miscellaneous & Involuntary [pg 1])

(0-6) (0-15)

Total Timed _____(Total Timed Overflow [pg 2] + Total Dysrhythmia

(Range 0-70) (Range 0-25) (Range 0-13)

[pg 2] + Total Timed Misc. [pg 2] + Total SFA [pg 3])

(Range 0-15) (Range 0-26)

Total PANESS_____- (Total Gaits and Stations +

(Range 0-119) (Range 0-49)

Total Timed)

(Range 0-70)

WALDROP PHYSICAL ANOMALY SCALE

Anomaly	**Scoring weights**
Head	
Head circumference	
>1.5S.D	2
1><1.5S.D	1
“Electric “ hair	
Very fine hairs that won’t comb down	2
Fine hair that is scorn away after combing	1
Eyes	
Epicanthus	
Where upper and lower lids join at the nose, point of union is	
Deeply covered	2
Partly covered	1
Hypertelorism	
Approximate distance between the tear ducts	
1.5S.D	2
1.25 to 1.5 S.D	1

Ears	
Low set	
Bottom of ears in line with:	
Mouth (or lower)	2
Area between the mouth and nose	1
Adherent lobes	
Lower edges of ears extend	
Upward and back towards crown of head	2
Straight back towards rear of neck	1
Malformed	1
Asymmeterical	1
Mouth	
High palate	
Roof of the mouth steepled	2
Roof of the mouth moderately high	1
Furrowed tongue	1
Hands	
Fifth finger	

Markedly curved inwards towards other fingers	2
Slightly curved inwards towards other fingers	1
Single transverse palmar crease	1
Feet	
Third toe	
Definitely longer than second toe	2
Appears equal in length to second toe	1
Partial syndactyly of 2 middle toes	1
Gap between 1st and 2nd toe (approx 1 inch)	1

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KEYS FOR MASTER CHART

Gender

Male - 1

Female - 2

Neurological Examination

Normal Neurological Examination - 1

Abnormal Neurological Examination - 2

Socio Economic Class

Upper Class - 1

Upper Middle - 2

Lower Middle - 3

Upper Lower - 4

Lower - 5

MASTER CHART

FOR CASE

NAME	AGE	SEX	NEUROLOGICAL EXAM	OVERFLOW (0-31)	GAITS AND STATIONS (0-49)	TOTAL TIMED (0-70)	TOTAL PANESS (0-119)	MPA SCALE (0-15)	SOCIOECONOMIC CLASS (1-5)
RISHI	11	1	1	16	4	34	38	6	2
KALPANA	11	2	1	16	4	18	22	5	2
RASHID	10	1	1	14	4	36	40	6	4
STEPHEN	10	1	1	6	2	11	13	2	4
SATHISH	11	1	1	8	4	30	34	5	4
SRIKANTH	11	1	1	17	22	36	60	6	3
SURYA	10	1	1	4	0	14	14	3	4
SATHYA PRIYA	10	2	1	10	6	32	38	3	4
SUBASHRI	10	2	1	4	0	33	33	5	4
DEVI	12	2	1	16	14	42	56	4	4
MURALI	13	1	1	2	0	15	17	2	3
ASHATH ALI	13	1	1	12	2	35	37	2	3
LEELA	9	2	1	15	8	35	43	6	2
VIDHYA	11	2	1	5	0	21	21	2	1
ILAYAVAN	11	1	1	18	12	34	46	5	2
SULTAN SUDEER	11	1	1	2	2	0	2	2	3
MONISHA	12	2	1	23	9	34	43	3	3
IMMANUEL	9	1	1	5	4	22	26	3	3
MUKESH	8	1	1	12	12	26	38	3	4
KASI	10	1	1	6	11	3	14	3	4
STALIN	9	1	1	16	8	40	48	7	4
RAMESH	12	1	1	4	2	39	41	5	4
ANTHONY	10	1	1	13	5	27	31	2	4
GEETHA	10	2	1	10	3	24	27	3	2

MASTER CHART

FOR CASE

FAIZAL BEGUM	9	2	1	5	4	17	21	5	1
SYED ALI	13	1	1	11	4	18	22	3	2
HARI	13	1	1	6	0	24	24	5	2
PRIYADARSHINI	9	2	1	24	16	48	64	6	3
RAGHU	10	1	1	13	3	30	33	3	3
ANITHA MARY	10	2	1	9	5	18	23	4	3
DIVYA	13	2	1	5	2	21	23	4	4
KARTHIK	9	1	1	11	14	29	43	6	3
KHADER BASHA	13	1	1	15	10	33	43	3	4
RAGHUL	11	1	1	12	9	31	40	4	4
ROSE	12	2	1	7	3	28	31	2	4
GANESH	12	1	1	5	1	13	14	4	4
SHEEBA	13	2	1	11	4	34	38	3	3
SARANYA	10	2	1	17	4	49	53	5	4
BHARATH	10	1	1	9	1	35	36	4	3
ANBU	9	1	1	22	5	47	52	3	4
SIVARANJANI	8	2	1	2	7	12	19	3	2
KAVITHA	11	2	1	3	2	15	17	1	3
RANJANI	10	2	1	7	5	29	34	5	4
DINESH	11	1	1	4	4	27	31	6	3
VINOTH	9	1	1	11	5	32	37	3	4
YUVRAJ	11	1	1	13	7	27	34	8	3
MOHAMMED	8	1	1	18	19	25	44	1	4
IBRAHIM	11	1	1	17	4	31	35	5	3
DIVYA	11	2	1	6	1	20	21	5	4
VASU	11	1	1	10	4	18	22	2	2

MASTER CHART

FOR CASE

MUKESH	12	1	1	21	18	39	57	4	2
SHANMUGAM	13	1	1	12	7	27	34	3	5
SHAKTHI	11	1	1	6	2	12	14	4	2
SHAKTIVEL	9	1	1	13	21	37	58	3	4
ANANDH	9	1	1	12	12	33	45	4	1
VALAVAN	11	1	1	23	18	52	70	8	3
THYAGU	11	1	1	8	3	20	23	1	2

MASTER CHART

FOR CONTROL

NAME	AGE	SEX	NEUROLOGICAL EXAM	OVERFLOW (0-31)	GAITS AND STATIONS (0-49)	TOTAL TIMED (0-70)	TOTAL PANESS (0-119)	MPA SCALE (0-15)	SOCIO ECONOMIC CLASS (1-5)
LAVANYA	8	2	1	12	11	30	41	4	2
SHERLEY	12	2	1	7	4	23	27	2	2
VELUMANI	11	1	1	0	6	10	16	7	2
LOGESH	10	1	1	8	4	18	22	1	2
SARANYA	9	2	1	6	8	13	22	3	2
PAVITHRA	10	2	1	10	2	19	21	5	3
ANUPRIYA	12	2	1	10	4	14	18	1	4
LOGANATHAN	12	1	1	8	4	21	25	3	4
LOGESH	11	1	1	6	0	17	17	2	4
HARI	8	1	1	9	9	19	28	1	2
VISHNU	9	1	1	5	4	18	22	2	3
SEKAR	10	1	1	0	4	6	10	7	5
REVATHY	13	2	1	4	2	16	18	6	1
VADIVEL	13	1	1	1	1	10	11	1	2
KAVYA	8	2	1	3	0	13	13	4	4
KURUVAMA	12	2	1	15	7	25	32	5	3
DEEPIKA	10	2	1	14	7	20	27	3	4
SHRUTHI	12	2	1	14	7	29	36	6	4
SARAN	9	1	1	11	12	31	43	5	2
KIRUTHIKA	10	2	1	2	14	14	14	1	3
IBRAHIM	11	1	1	13	6	27	33	8	4
ANITHA MARY	12	2	1	2	0	16	16	2	2
KAJAL	13	2	1	2	5	6	11	1	1
RAJESH	8	1	1	6	3	19	22	4	4
TAMILARASAN	11	1	1	8	3	12	15	1	2

MASTER CHART

FOR CONTROL

KAVIARASAN	10	1	1	11	8	21	29	0	3
MUGILAN	9	1	1	5	5	6	11	2	4
BHARANI	12	1	1	6	7	10	17	2	4
SANJANA	8	1	1	13	4	28	32	6	4
SAMUEL	9	1	1	9	6	27	33	3	4
DIVYA	10	2	1	4	0	20	20	2	3
SELVI	10	2	1	8	5	32	38	5	3
DINESH	12	1	1	3	0	16	16	5	3
RASHID	11	1	1	8	4	22	26	3	2
SENTHIL	12	1	1	4	2	12	14	3	4
KAVITHA	9	2	1	18	0	34	34	4	2
ABU ALI	11	1	1	4	0	14	14	2	4
RAHUL	8	1	1	2	0	8	8	4	2
RAMESH	8	1	1	20	6	40	46	7	3
RAMYA	8	2	1	10	0	36	36	4	4
RAGHU	9	1	1	4	4	29	33	3	2
SAMUEL	8	1	1	16	0	40	40	3	4
SAKUNTHALA	10	2	1	8	4	30	34	2	2
AKASH	10	1	1	2	6	14	20	5	4
JEGAN	10	1	1	7	4	13	17	5	2
PREM KUMAR	12	1	1	5	1	11	12	3	3
PARTHIBAN	10	1	1	0	2	4	6	2	3
PRADEEP	11	1	1	0	4	2	6	3	2
THARA SENTHAMIZH	11	2	1	0	4	18	22	3	4
APPUN RAJ	11	1	1	12	10	18	52	8	3
ANTONY	13	1	1	3	0	5	5	9	4

MASTER CHART

FOR CONTROL

ANAND	8	1	1	12	8	29	37	4	4
FATHIMA	11	2	1	16	7	37	44	6	5
FAISAL	10	1	1	10	2	26	28	5	5
MEENALOCHANI	12	2	1	0	0	12	12	4	1
ARUN	9	1	1	17	11	41	52	5	2
RAJESH	13	1	1	12	2	22	22	0	